Issued June 13, 1911.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF CHEMISTRY—BULLETIN No. 139.
H. W. WILEY, CHIEF OF BUREAU.

AMERICAN MINERAL WATERS:

THE NEW ENGLAND STATES.

BY

W. W. SKINNER,
Chief, Water Laboratory.

WITH A CHAPTER ON

BACTERIOLOGICAL METHODS,

BY

G. W. STILES, JR.,
Bacteriological Chemist.

PREPARED UNDER THE DIRECTION OF
J. K. HAYWOOD,
Chief, Miscellaneous Division.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
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LETTER OF TRANSMITTAL.

U. S. Department of Agriculture,
Bureau of Chemistry,
Washington, D. C., February 11, 1911.

Sir: I have the honor to transmit for your inspection and approval a manuscript prepared in the Miscellaneous Division of the Bureau of Chemistry reporting the results of an investigation of the character of American mineral waters. This work was performed by your authority in cooperation with the Hydrographic Branch of the United States Geological Survey. I recommend that this report be published as Bulletin No. 139 of the Bureau of Chemistry.

Respectfully,
H. W. Wiley,
Chief of Bureau.

Hon. James Wilson,
Secretary of Agriculture.

LETTER OF SUBMITTAL.

U. S. Department of Agriculture,
Bureau of Chemistry,
Washington, D. C., January 30, 1911.

Sir: I have the honor to submit for your inspection and approval a manuscript giving some of the results of an investigation conducted by Mr. W. W. Skinner, Chief of the Water Laboratory of the Miscellaneous Division, on the character of American mineral waters as sampled at source. This is the first of a series of bulletins to be issued on this subject and includes only waters from the New England States. The investigation is of great importance to the public, especially to physicians who desire an absolutely reliable statement as to the character of a water when prescribing its use. The waters examined are those reported in Mineral Resources, published by the United Stated Geological Survey. From time to time as other springs develop additional data will be issued. The Hydrographic Branch of the Geological Survey, under the direction of Mr. M. O. Leighton, cooperated in the work to the extent of collecting most of the samples. Credit is also due Messrs. W. D. Collins and D. C. Dyer, of the Water Laboratory, who assisted in the analytical work.

I recommend that the report be published as a bulletin of this bureau.

Respectfully,
J. K. Haywood,
Chief Miscellaneous Division.

H. W. Wiley,
Chief Bureau of Chemistry.

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INTRODUCTION.

MINERAL WATERS DEFINED.

The term mineral water has been variously defined, the definition having gradually changed from the restricted sense, meaning a water used only for medicinal purposes, to a water used for drinking or sometimes bathing purposes. Thus Dr. Peale, in his report to the Geological Survey on the statistics of mineral waters and the mineral-water industry of the United States, says: "Our reports do not restrict the term 'mineral water' to medicinal waters, but include all waters put on the market, whether they are utilized as drinking or table waters, or for medicinal purposes, or used in any other way."

Bailey, in a special report of the Kansas Geological Survey, quotes Ossian Henry to the effect that "Mineral waters are those waters which, coming from the bosom of the earth at variable depths, bring with them substances which may have upon the animal economy a medicinal action capable of giving rise to effects often very salutary in the different diseases affecting humanity," and he further quotes M. Durian-Fardel to the effect that mineral waters are those "natural waters which are employed in therapeutics because of their chemical composition or their temperatures."

Walton, in his history of the mineral springs of the United States and Canada, defines a mineral water, in the medical acceptation of the term, as one which, by virtue of its ingredients, whether mineral, organic, or gaseous, or the principle of heat, is especially applicable to the treatment of disease.

Clark [1] says that between the so-called mineral waters and waters of ordinary character no proper line of demarcation can be drawn. In fact, some of the springs having the greatest commercial importance yield waters of exceptionally low mineral content and owe their value to their remarkable purity. They are simply potable waters carrying a minimum of foreign matter in solution. Other springs, on the contrary, are characterized by excessive salinity, and between the two extremes nearly every intermediate condition may be observed.

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[1] Data of Geo-Chemistry, U. S. Geological Survey Bul. 330, p. 139.

Salisbury [1] defines a mineral water as one that contains (1) much mineral matter, (2) mineral matter which is unusual in spring waters, or (3) mineral matter which is conspicuous because of its odor, color, or taste.

According to the definition adopted by the International Food Congress [2] held in Paris in 1909, "A mineral water is a natural water proposed for consumption on account of its special therapeutic or hygienic properties."

This comprehensive definition of a mineral water has been used in preparing this report, which includes waters used for drinking purposes, irrespective of whether they may be regarded as medicinal waters and used for the therapeutic value of their mineral constituents or are simply called table waters and used because of their purity or hygienic qualities.

NATURAL WATERS DEFINED.

The definition of a natural water as distinguished from an artificial water would at first seem to be a comparatively simple matter. From what is said, however (p. 11), concerning the possible complexity of a water it is evident that a simple definition, categorically stated, is not easy to formulate to the satisfaction of all interested persons. Thus, a water issuing from a natural orifice in the earth under pressure and highly charged with mineral matter and carbon dioxid, may, in a short period of its flow, deposit either iron or calcium salts, or both, and become thereby greatly changed in its character. Is a water so changed to be still considered a natural spring water in the strictest interpretation of the term? Or, if the natural spring basin is large enough to hold the product of the spring for a sufficient time to allow the escape of carbon dioxid and the resultant precipitation of iron and calcium salts, is such water to be regarded as a natural water? If such waters are to be classed as natural, then how shall we classify waters that have been simply stored in tanks or artificially constructed spring basins until such precipitation has occurred? These and similar questions were given thorough consideration by the First International Food Congress,[3] which met in Geneva in 1908, and after a vigorous discussion, participated in by the scientists and mineral-water producers of Europe, the following resolution was adopted: "A natural water is, from a commercial point of view, that which at its place of origin, as it bursts forth from the ground, is directly placed in the same receptacle

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[1] Physiography, 1908, p. 90.

[2] Compte rendu des travaux du 2e congrès international pour la répression des fraudes alimentaires et pharmaceutiques, Paris, 1909.

[3] Compte rendu des travaux du 1er congrès international pour la répression des fraudes alimentaires et pharmaceutiques, Genéve, 1908.

in which it is delivered to the consumer." This congress also decided that it should be permissible to transport water through pipes, to employ mechanical pumping, and to store water in closed tanks established at the springs to hold the supply from springs of feeble yield. But it was further specified that no manipulation to modify the character of the water would be allowed, and that all manipulation to which the water was subjected should be stated on the label affixed to the container filled at the spring and in which it must be delivered to the consumer.

At the Second International Food Congress,[1] held in Paris in 1909, the definition of a natural potable mineral water adopted at the Geneva congress was readopted with a slight modification, as follows: "A natural water is, from a commercial point of view, a water free from harmful germs, which at its place of origin, as it bursts forth from the ground, is directly placed in the same receptacle in which it is delivered to the consumer." It was further provided that the term "table water" should be applied exclusively to natural waters, and that the terms "gaseous" or "aerated" should also imply a natural mineral water. It was further provided that "All manipulations must be visibly indicated on the label affixed to the receptacle containing the water, in which receptacle it is delivered to the consumer." Other points of interest to the mineral-water trade passed upon by this congress are as follows:

1. That it be forbidden to give a natural water, a natural mineral water, or an artificial water the name of a preexisting spring or locality known for a spring.
2. That the same natural water or natural mineral water shall not be delivered to the consumer under two different names.
3. That artificial waters shall be sold in receptacles, a special form like syphons; that the said receptacles shall necessarily have a label bearing the words "Artificial waters" followed by the indication of the manipulations to which the water has been subjected.
4. That seltzer water may only be prepared with sterilized water, pure water, and commercially pure carbonic acid.
5. Any water not complying with the definitions of a natural water before stated or having been manipulated otherwise than above should be termed "artificial." Water, however, into which carbonic acid gas has been introduced but which has not been otherwise manipulated may be described as seltzer water.
6. The expression "Natural salts" coupled with the name of a spa applies only to the integral residue of the evaporation of the natural mineral water of that spa.
7. That it is forbidden to employ the name of a spa to designate the hygienic or nonofficial pharmaceutical product unless the active principle of such product be solely composed of the natural salts of the spa thus indicated.

A natural mineral water, according to the definition adopted by the Board of Food and Drug Inspection, United States Department of Agriculture,[2] is a water that has had nothing added to it or abstracted from it after issuing from source.

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[1] Loc. cit.

[2] Food Inspection Decision 94.

SPRINGS v. WELLS.

The definition of the term "spring," as used to distinguish that source of water supply from a well, is quite important, especially from a commercial viewpoint. Many of our American mineral waters said to come from springs are in reality from wells. That there is a difference in the potency of waters of the same or similar character, whether from wells or springs, is inconceivable, yet the word "spring" is of much greater trade value when applied to a mineral water, as is attested by its almost universal use. Probably the best definitions are those which characterize a spring as water rising naturally to the surface of the earth and either flowing away in the form of a small stream or standing as a pool or small lake, while a well is an artificial excavation in the earth in which water rises or flows. The term "artesian" is usually applied to a well which is quite deep and which taps a vein in which the water is under considerable hydrostatic pressure. Originally the term "artesian" was applied to flowing wells only; but as the flow often depends as much or more upon the conformation of the surface of the earth at the particular spot where the well is located as it does upon hydrostatic pressure, the first definition seems preferable. The term "subartesian" is sometimes employed to denote wells in which the water rises under some pressure but not enough to cause the water to flow above the surface.

That a well and a spring may, and oftentimes do, yield identical supplies, coming from the same water-bearing stratum, is not sufficient warrant for the use of these terms synonomously, as is done in some localities, notably Saratoga, where wells have been bored to tap the highly mineralized waters found in the deep water-bearing strata and yield a product comparable in its mineralization and character to the original springs.

ORIGIN OF GROUND WATERS.

All ground waters (spring and well waters) are primarily of meteoric origin; that is, they originate from the precipitation upon the earth's surface of moisture, in the form of rain and snow, which percolates through the upper strata of the earth's crust and flows toward a lower level, to appear again in some cases in the form of springs, either at the earth's surface or in the ocean bed, or to appear in wells. This theory of the vadose origin of mineral springs has been disputed recently by Suess,[1] due to a study which he has made of the Carlsbad Springs, from which he concluded that geysers and hot springs are of hypogene or direct magmatic origin. This is

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[1] Verh. Gesell. d. Naturf. Aerzte, 1902, 74: 133.

controverted by McLaren,[1] Swarz,[2] and others. Swarz does not believe that water from volcanoes and hot springs comes from original magma but is vadose or surface water, and that the heat can be accounted for by assuming sudden pressures or stresses in the earth's crust, the resulting energy being translated into heat. Whether some of our American hot springs and geysers, notably those of the Rocky Mountain region, may not be of surface origin, is for future geological investigation to determine. It seems reasonable to assume, however, in the light of our present knowledge, that the mineral springs in the eastern section of the United States, especially those producing potable waters, and considered in this bulletin, are of vadose origin.

CHEMICAL AND PHYSICAL AGENCIES AFFECTING COMPOSITION.

Water being the natural and almost universal solvent, it follows that its mineral characteristic is determined by the character of the rocks and minerals in the earth through or over which the water has passed. Falling in the form of rain or snow, water in the very beginning of its cycle absorbs certain gaseous and solid organic and mineral substances. Chemical action resulting in the solution of mineral matter begins as soon as the water starts on its downward course through the earth. The oxygen, carbon dioxid, and organic matter abstracted from the air are extremely active agents in the decompositions subsequently taking place. The oxygen necessary for the oxidation and subsequent solution of certain mineral matter may be afforded entirely, according to Geike,[3] by the volume of this element absorbed by rain water falling through the atmosphere; or there may be a deoxidation and a resulting solution of otherwise refractory mineral matter, the deoxidation being due to the decomposition of organic matter absorbed from the atmosphere or taken into solution by the water while passing through the surface foot or two of soil. One of the products of the decomposition of organic matter is carbon dioxid (CO_2), a notably active agent in the decomposition of certain classes of rocks, especially the carbonate rocks of the limestone type. Upon carbonates of calcium and magnesium, carbon dioxid exerts a marked effect. The normal carbonates of these elements are relatively quite insoluble in water free from carbon dioxid. But when carbon dioxid is present these rocks are vigorously attacked and go into solution probably as the bicarbonate of calcium [$Ca(HCO_3)_2$] and the bicarbonate of magnesium [$Mg(HCO_3)_2$]. Some rocks containing iron are also vigorously acted upon by water charged with carbon dioxid, the iron going into solution as ferrous bicarbonate

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[1] Geological Magazine 1906, p. 511.
[2] Geological Magazine 1904, p. 252.
[3] Text Book of Geology, 4th ed., 1903.

[$Fe(HCO_3)_2$]. These bicarbonates, especially the calcium and magnesium salts, are the constituents which produce that characteristic of waters known as hardness. If such waters are boiled the bicarbonates are decomposed, the carbon dioxid passing off, the less soluble normal carbonate being precipitated according to the following equation: $Ca(HCO_3)_2 = CaCO_3 + CO_2 + H_2O$.

The iron and magnesium bicarbonates are similarly decomposed by boiling. The normal magnesium salt, however, being much more soluble than the corresponding calcium salt, the magnesium can not be so completely removed from solution by the decomposition and precipitation. Waters containing these bicarbonates which are decomposed by boiling are said to be temporarily hard as distinguished from waters containing other salts of calcium and magnesium, as for instance, the sulphates, chlorids, and nitrates, which can not be decomposed and removed by boiling. For this reason waters containing the latter salts are said to be permanently hard.

Solution of readily soluble mineral matter without an accompanying chemical decomposition is also a large factor in determining the character of mineral waters. Thus when water in its passage through the earth comes in contact with strata of such readily soluble material deposited in some former geologic era it may become saturated with such salts. As the salinity of the water in its passage through the rocks is increased its solvent power for certain minerals is also increased, and often a substitution occurs, the water taking up certain mineral constituents and depositing some of the mineral matter already held in solution.

Even after the water has become more or less mineralized, further changes due to both chemical and physical agencies may alter its character. Lefort, in discussing the subject, says: "Mineral waters when they are exposed to contact with air suffer a modification or alteration which has a cause exclusively chemical or both mechanical and chemical. Certain minerals, among them bicarbonates, have a tendency to lose carbon dioxid; therefore, some salts, no longer protected by the great excess of gases which existed in the mineral water in the state of oversaturation and being by nature easily altered, absorb one of the elements of the air (oxygen) and become completely modified." As examples of these two classes of change, may be mentioned the decomposition of ferrous bicarbonate and the changes produced in waters containing the sulphur compounds.

Another important factor involved in the change of the mineral character of a water is a change in pressure. The solubility of gases in water increases with pressure, which in some cases affects the solubility of certain salts. It follows, therefore, that water charged to supersaturation with a gas may undergo a marked transformation when the gas is released either by the water issuing at the surface or flowing into an unconfined subterranean channel, the result being that some of the mineral matter held in solution is thereby precipitated. Other changes may also occur owing to the mingling in subterranean crevices of several streams of water characterized by a content of different mineral salts, some of which may be chemically incompatible in solution; the direct result of such mingling is therefore a deposition of a portion of the mineral matter.

The quantity and character of the mineral matter held in solution in the mineral waters of any region may therefore be taken as a partial index of the work, both chemical and physical, performed by the water in its passage through the various strata forming the earth's crust, and, as has been truly said,[1] "The rock formations of the earth to the depths to which ground water penetrates are to be looked upon as a sort of chemical laboratory through which waters are circulating in all directions charged with all sorts of chemical substances."

A mineral water is not therefore a simple but a complex substance which may vary from time to time, and, indeed, there is reason to believe that some springs may have both a slight, periodic, and seasonal variation. Such changes, however, either in flow or in the character of the mineral content, are generally accepted as evidence of a shallow or local origin, or, to state the matter conversely, when a spring flow is constant as to quantity and character, it may be accepted as evidence of a deep-seated source of supply. This is particularly true if a spring is at all highly mineralized. However, changes due to artificial causes should not be confounded with changes due to natural causes. Thus, certain springs in New York have greatly decreased in mineral content in recent years, owing undoubtedly to the very great amount of water taken from them and from deep wells which have been drilled to tap the source of supply and increase the output, while certain well-known mineral waters of the Middle West obtained from wells are pumped only one day in every seven to ten day period. If pumped oftener the mineral content falls to less than half its normal quantity.

PROBLEM FOR INVESTIGATION.

Statistics of the mineral water industry of the United States compiled by Sanford[2] show that there was produced in 1908 (the latest statistics available) over 56,000,000 gallons of bottled mineral waters, with a value at the springs of $7,287,269. This value, however, does not begin to represent the total value of the industry. Probably an amount of water of equal value was furnished to guests at our many mineral-spring resorts. A large but unknown quantity

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[1] Chamberlain and Salisbury, Geology, v. 1, 1904.

[2] U. S. Geological Survey, Mineral Resources, 1908.

was used also in the production of bottled soft drinks. It would seem, therefore, that a conservative estimate of the total value of the industry in 1908 would place it at probably $20,000,000. The value of most of these waters depends to a large extent upon the constituents, which give to them their therapeutic character or their hygienic quality. It follows, therefore, that an accurate chemical and bacteriological analysis is a matter of the greatest importance to the public—the consumers of the product—to the physicians who prescribe the waters, and to the commercial interests involved.

In a preliminary study of 41 samples of representative American mineral waters made by Haywood [1] it was found that the analyses compiled by Walton,[2] Crook,[3] and others were often inaccurate, incomplete, and for most purposes of no value. This is in no sense a reflection upon the authors named, but is due to the fact that many of the analyses were made years ago by methods more or less crude and inaccurate and frequently by persons of no particular skill in water analysis. And probably in some cases, though the analysis was correctly made, the samples before reaching the chemist had been so doctored or sophisticated that they did not in any way represent the supplies from which they purported to come. This assumption is warranted in some instances from a comparison of the analyses made by this Bureau with previous analyses made by reputable chemists, in which the disagreement is so marked and the changes so unlikely to have been produced by natural causes as to lead to but one conclusion, namely, that the previous analyses were not made on authentic samples. This fact should be considered in connection with the tabulated statement of the results of the advertised analyses appearing upon subsequent pages; it also emphasizes the need for this investigation, to the end that the public in general and physicians in particular may have authoritative information as to the character of a water used or prescribed.

COLLECTION OF SAMPLES AND METHODS OF ANALYSIS.

When it was decided that it was desirable and necessary to make a complete study of the character of the mineral waters of the United States, the assistance of the Geological Survey was sought and the Hydrographic Branch of that service cooperated with the Bureau of Chemistry in the undertaking. It was from the first recognized that if the results were to be authentic and to represent truly the waters named, it was necessary not only that the samples should be obtained under the strictest official supervision but by inspectors whose judgment could be relied upon to take them directly from source and to

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[1] U. S. Dept. Agr., Bureau of Chemistry, Bul. 91.

[2] Mineral Waters of the United States and Canada, 1883.

[3] Mineral Waters of the United States, 1899.

detect any sophistication should it be attempted. The cooperation with the Hydrographic Branch of the United States Geological Survey was particularly fortunate because of their efficient field force, consisting of men intimately acquainted with the local conditions where the samples were to be obtained. Four-gallon samples were collected in 2-gallon glass demijohns, which before being used were subjected to special treatment to reduce to the minimum the danger due to the possible solvent action of the water upon the glass; whenever a demijohn was found with a high coefficient of solubility it was discarded. The sample was taken directly from the spring whenever possible—never from tanks or pipes if it could be avoided. In the few cases where the water was covered by a cement or other immovable cover so that the sample could not be obtained directly from the spring, the fact has been stated in the description accompanying the analysis. As soon as the sample was obtained it was sealed and sent to the Bureau of Chemistry for examination, where the following determinations were at once made: Bicarbonic acid (HCO_3), nitrous acid (NO_2), nitric acid (NO_3), ammonium (NH_4), hydrogen sulphid (H_2S), carbon dioxid (CO_2), chlorin (Cl). The sample was then divided into the several portions necessary for the complete mineral analysis, and if for any reason the examination was delayed these several portions were acidified with hydrochloric acid to reduce to a minimum any action on the glass container by which the composition of the sample, owing to the soluble constituents of the glass, might be altered.

The samples for bacteriological examination, collected by the bacteriological chemist of the Bureau of Chemistry, were taken in duplicate, packed in ice, and shipped to the bureau for examination. A sanitary survey was also made by the bacteriological chemist at the time of collecting these samples, and a full report was made on the spot of the sanitary conditions of the spring and its surroundings at that time. This fact should be borne in mind in considering the statements descriptive of each spring.

The methods of analysis employed throughout were in all essential details those published by Haywood,[1] with some slight modifications when the peculiar character of a particular water or experience suggested an advisable variation.

The method for iodin and bromin devised by Haywood was used throughout in the determination of these elements. A further study was also made of the method, which emphasized the great delicacy of the reaction, especially for iodin. It was found that 0.01 mg of iodin in 100 cc of water could be readily detected without concentration, and that by this colorimetric method, determinations of one-tenth part per million of iodin were easily made.

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[1] U. S. Dept. Agr., Bureau of Chemistry, Bul. 91.

The manganese in about one-half of the samples was determined by the bromin oxidation method, as given in Bureau of Chemistry Bulletin 91, but it was found that with the small amounts of manganese usually present in mineral water the method was not entirely satisfactory, results often being discordant, thus necessitating another determination. A colorimetric method described by Hillebrand[1] was finally adopted, with very gratifying results, both because of the delicacy of the reaction and the ease of manipulation. This method depends upon the oxidation of the manganese present to permanganic acid, the color produced being compared with a standard solution of potassium permanganate. The method is as follows:

Make 100 cc of the water (or 1 liter concentrated to this volume) strongly acid with nitric acid, then add a sufficient quantity of a silver nitrate solution (2 grams of silver nitrate to 1 liter) to precipitate all the chlorin; add an additional 10 cc of the silver nitrate solution for each milligram of the manganese expected; agitate the solution to coagulate the silver chlorid, and filter. To the clear solution add approximately 1 gram of ammonium persulphate. Place on the steam bath and the pink color due to permanganic acid will soon appear, reaching a maximum in about 20 minutes. Remove the solution from the steam bath, cool, make up to a definite volume, and compare the color in Nessler tubes or in a Schreiner colorimeter with a standard solution of potassium permanganate. Instead of the permanganate, a standard solution of manganese sulphate may be employed, a convenient solution being one containing the equivalent of 2 mgs of manganese to 10 cc. For comparison oxidize 10 cc or other convenient aliquot of this solution with the silver salt and ammonium persulphate, parallel with the water under examination, make the final solutions to definite volume, and compare in the usual way. The reaction is an exceedingly delicate one, 0.01 mg of manganese in 100 cc of water being easily determined. No other element usually found in mineral waters seems to interfere with the delicacy of the reaction.

For the determination of lithium the method devised by Gooch, in which amyl alcohol is used to separate the mixed alkali chlorids, was used in all cases where a weighable amount of lithium was found. This method, which is reported in detail by Haywood,[2] has been subjected to additional investigation, and its absolute reliability as a precise method is amply confirmed. A failure to obtain satisfactory results by the method is usually due to magnesium which has not been entirely removed from the mixed chlorids. It is therefore essential that the residue obtained after removing the amyl alcohol, and supposedly lithium sulphate, should be tested for magnesium with a few drops of ammonium hydroxid and ammonium phosphate, allowed to stand 24 hours, filtered, ignited, and weighed. If any magnesium is found it should be calculated to sulphate and subtracted from the sulphate residue from the amyl alcohol. A failure to observe this precaution will frequently lead to grave error.

Because of the very small amount of lithium found in most mineral waters and the necessarily limited amount of water available for analysis in an investigation of this character, a method which

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[1] U. S. Geological Survey, Bul. 305.

[2] U. S. Dept. Agr., Bureau of Chemistry, Bul. 91.

would at least approximately determine an amount of lithium equivalent to 0.01 of a part per million or less seemed highly desirable. Naturally, the employment of some method which would take advantage of the very delicate emission spectrum of lithium suggested itself as a possible means of solving the problem. A search of the literature showed that such attempts had been made. A dilution method based on the disappearance of the lithium line was proposed by Ballmann[1] and later modified by Bell.[2] A spectroscopic method has also been proposed by Fruchot.[3] Bell's method was tried, but the results were far from satisfactory, and it was believed that the Fruchot method gave more promise of satisfying the needs of the problem in hand. With the assistance of W. D. Collins, of the Water Laboratory, the method has been finally so modified and perfected that results of great accuracy may be obtained in solutions of high dilution. By this method, using a hydrogen flame, a quantity of lithium equal to 0.00001 mg of lithium in 1 cc of solution can be detected, while variations of 0.00001 and 0.00002 can be determined with a fair degree of accuracy. The smallest amount of lithium which it is possible to detect with the spectroscope, using a hydrogen flame, is about 0.0000001 mg. This method has been employed in checking most of the analyses for this report. Where lithium is reported as a trace it means that no weighable amount was determined by the amyl alcohol separation using the amount of water noted, but by examination with the spectroscope the lithium line was found.

METHOD OF STATING RESULTS.

The results of the chemical analysis have been first stated in the so-called ionic[4] or radical form followed by a statement of the hypothetical combinations, calculated from the former according to the empirical method formulated by Haywood,[5] in which the sodium is first combined with nitrous, nitric, and metaboric acids, potassium with iodin and bromin and calcium with phosphoric acid. The residual basic ions are then assigned in the following order—ammonium, lithium, potassium, sodium, magnesium, calcium, manganese, iron, and aluminum; the residual acid ions in the following order—chlorin, sulphuric acid, bicarbonic acid, and carbonic acid. In case

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[1] Zts. anal. Chem., 1875, 14: 297.

[2] Amer. Chem. J., 1885, 7: 35.

[3] Compt. rend., 1871, 73: 1022.

[4] The term "ion" employed throughout the statement of analyses is used in its most comprehensive sense and to replace the less comprehensive term "radical" heretofore employed. The use of the term to include both actual and potential ions is sanctioned by Ostwald, Principles of Inorganic Chemistry, p. 244. The same difficulty is experienced in the statement of silica as under the older form of statement. Whether silica exists in waters in combination as soluble silicate or in a colloidal form has not been definitely determined. Evidence collected by the author indicates that in some cases soluble silicates do exist, and when necessary to balance an analysis this view has been taken throughout the bulletin.

[5] U. S. Dept. Agr., Bureau of Chemistry, Bul. 91.

the bicarbonic acid ion is not present in sufficient quantity to balance all the residual calcium, the remaining calcium is combined as calcium silicate, and the manganese, iron, and aluminum are calculated to the oxids of manganese (Mn_3O_4), iron (Fe_2O_3), and aluminum (Al_2O_3), respectively. It was at first thought desirable to omit the statement of results in the form of the hypothetical combination as suggested by Haywood,[1] but inquiry revealed the fact that to do so would materially decrease the value of the work for physicians and others who have been in the habit of interpreting a water analysis only in terms of the salts supposedly held in solution. In recognition of this fact the hypothetical combinations have been inserted. It should be remembered, however, in interpreting the results of the chemical analysis that no claim is made that the several salts do exist in the exact proportion as given, but that with the ions as stated in any particular case their most probable combination as salts would be as given in the hypothetical statement of results.

The data which were found concerning previous analyses are given under the heading "Advertised analyses." Whenever possible, the name of the analyst is stated. If no advertised analysis could be obtained, analytical data from either Crook or some other published report was used, the source in each case being quoted. The original data have been recalculated to a uniform basis of parts per million and restated as ions. The hypothetical compounds have been calculated also from these ions to conform to the scheme outlined on page 17. This change of statement was necessary for purposes of comparison with the author's results, which conform to the most approved method of stating water analyses.

The statement of the sanitary analysis complies with the customary form among chemists of reporting these results, and a complete description of the bacteriological methods and a statement of the results obtained are given in a special section on the subject (p. 22).

CLASSIFICATION OF WATERS.

A prime requisite in an investigation of this character is some good scheme of classification. This is especially of importance to commercial interests, as well as to people interested in the scientific aspect of the work, for by such a classification waters of similar character may be brought together for easy study and comparison. Numerous classifications of mineral waters have been suggested. Indeed, it would almost seem that each person giving special attention to this subject has adopted a new classification formulated by himself. This is undoubtedly due to the complexity of the subject, no one classification seeming to meet all requirements. The arrangement may be chemical, therapeutic, geological, or geographical, the first, however, being the most scientific and satisfactory. The classifica-

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[1] Loc. cit.

tion suggested by Haywood,[1] based upon chemical principles, while somewhat cumbersome because of the complex characters to be considered, is probably the best that has yet been offered. Haywood's scheme is as follows:

HAYWOOD'S CLASSIFICATION.

GROUP.	CLASS.	SUBCLASS.		
Thermal Nonthermal	I. Alkaline	Carbonated or bicarbonated Borated Silicated	Sodic Lithic Potassic Calcic Magnesic Ferruginous Aluminic Arsenic Bromic Iodic Siliceous Boric	Nongaseous. Carbondioxated. Sulphureted. Azotized. Carbureted. Oxygenated.
	II. Alkaline-saline	Sulphated Muriated Nitrated		
	III. Saline	Sulphated Muriated Nitrated		
	IV. Acid	Sulphated Muriated		

Thermal waters may be defined as those which issue from the earth at a markedly higher temperature than the surrounding atmosphere throughout the whole year, and nonthermal waters as those which issue from the ground at approximately the same temperature or less than the temperature of the surrounding atmosphere throughout the whole year. By reason of the fact, however, that such a classification would produce a sliding scale, and would classify as thermal a water which in a warmer climate would be nonthermal, it has been thought best to adopt the scheme proposed by A. C. Peale, and classify all waters above 70° F. as thermal, and all below as nonthermal. Waters between 70° F. and 98.6° F. would, according to this classification, be considered as tepid or warm, while waters above 98.6° F. would be considered as hot.

Alkaline waters are (1) those which have an alkaline reaction[2] and contain carbonic or bicarbonic acid ions in predominating quantities; (2) those which have an alkaline reaction and contain boric or silicic acid ions in predominating quantities, where it can be demonstrated that the alkalinity is largely due to the presence of borates or silicates. The first class of alkaline waters is well known and is given in Peale's classification as constituting the whole class of alkaline waters. The second class includes those which are more alkaline than can be accounted for by the carbonates or bicarbonates present, and contain predominating quantities of silicates or borates which evidently cause this excess of alkalinity.

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[1] Loc. cit.

[2] When acid and alkaline reactions are mentioned in these definitions, methyl orange is supposed to be used as indicator.

Saline waters are those which have an alkaline or neutral reaction and contain sulphuric, muriatic, or nitric acid ions in predominating quantities.

Alkaline-saline waters are those with both alkaline and saline characteristics. They embrace those which have an alkaline reaction and contain (1) sulphuric, hydrochloric, or nitric acid ions, together with carbonic or bicarbonic acid ions, both classes being present as predominating constituents, or (2) those which have an alkaline reaction and contain sulphuric, hydrochloric, or nitric acid ions with boric or silicic acid ions, both classes being present as predominating constituents, where it can be demonstrated that the alkalinity is largely due to the presence of borates or silicates.

Acid waters are those which have an acid reaction and contain either sulphuric or muriatic acid ions in predominating quantities.

METHOD OF NAMING MINERAL WATERS.

If any basic element is prominent in the mineral water this fact may be indicated by prefixing the base to the regular class name, as sodic, lithic, calcic, etc.; carbonated alkaline, borated alkaline, silicated alkaline, sulphated alkaline-saline, etc.

If any basic or acid ion is prominent therapeutically but not chemically, this fact may be indicated by affixing the name of the basic or acid ion to the regular name, as carbonated alkaline (arsenic, bromic, iodic, etc.).

The gaseous constituents of all the foregoing classes of waters may be designated by the following terms:

Nongaseous	Containing no gas.
Carbondioxiated [1]	Containing carbon dioxid gas.
Sulphureted	Containing hydrogen sulphid gas.
Azotized	Containing nitrogen gas.
Carbureted	Containing methane gas.
Oxygenated	Containing oxygen gas.

The following scheme enables one to name any mineral water according to Haywood's classification:

Thermal or non-thermal.

- Sodic.
- Lithic.
- Potassic.
- Calcic.
- Magnesic.
- Ferruginous.
- Aluminic.

- Alkaline.
  - Carbonated or bicarbonated
  - Borated
  - Silicated
- Alkaline saline.
  - Sulphated
  - Muriated
  - Nitrated
- Saline.
  - Sulphated
  - Muriated
  - Nitrated
- Acid.
  - Sulphated
  - Muriated

- Arsenic.
- Bromic.
- Iodic.
- Siliceous.
- Boric.
- Lithic.
- Ferruginous.
- Etc.

- Nongaseous.
- Carbondioxated.
- Sulphureted.
- Carbureted.
- Oxygenated.

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[1] This word is introduced so as to distinguish between free carbon dioxid and carbon dioxid in combination.

It is believed that if such a nomenclature as this were used the general public would be able to obtain more information from the name alone than from the inspection of an analysis. It is apparent that much work would be saved for the physician, who could soon reduce the waters to be considered in any given case to a comparatively small number simply by the use of a well-arranged index, instead of being compelled to study hundreds of analyses. The group, class, and subclass having been determined, it would be a comparatively easy matter to study the individual analyses.

For ease in comparison waters may be further classified according to their total saline content. Throughout this bulletin the following classification has been used:

40 parts or less per million	Very lightly mineralized.
40 to 75 parts per million	Lightly mineralized.
75 to 200 parts per million	Moderately mineralized.
200 to 500 parts per million	Highly mineralized.
500 and over parts per million	Very highly mineralized.

This classification is based upon the fact that most surface waters[1] in the East approximate 100 parts per million of salts in solution and may be considered therefore as moderately mineralized. The other subdivisions are purely arbitrary, but are believed to be useful in extending the classification.

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[1] Twenty-four rivers of the Atlantic seaboard were found by Dole to average for one year 82 parts per million of evaporated residue at 180° C. U. S. Geological Survey, Water-Supply Paper 236.

BACTERIOLOGICAL EXAMINATION.

By George W. Stiles, Jr.

INTRODUCTION.

A pure and wholesome water supply is now generally recognized by the public as a necessity, and the need is further emphasized when the problem is considered from the viewpoint of reducing the death rate from preventable causes. It has been suggested by Hazen, and confirmed by Sedgwick and MacNutt,[1] that "for every death from typhoid fever avoided by the purification of a polluted water supply, two or three deaths are avoided from other causes, * * * conspicuous among these 'other causes' are pneumonia, pulmonary consumption, bronchitis, and infant mortality." These investigations point out the relationship existing between polluted water as a potent factor in disease dissemination and the mortalities ordinarily ascribed to bacterial diseases.

The problem of obtaining relatively pure drinking water becomes more complicated as population increases. That the public realizes this fact is attested by the annual increase in the consumption of bottled mineral waters, the cost of which now amounts to millions of dollars yearly. As the consumption of bottled waters is dependent largely upon a belief in the purity and wholesomeness of the product, an investigation of American mineral waters from source would be incomplete without a study of the bacteriological character of the several springs investigated. Deep-seated springs and artesian wells are usually comparatively free from bacterial life, while shallow wells and springs, especially in close proximity to human dwellings, often show evidences of serious pollution of animal origin.

Bottled waters may show dangerous pollution, originating from polluted springs, dirty bottles, or insanitary handling of the product. Water from uncontaminated springs, put up in properly cleansed bottles, is usually free from objectionable bacteria. Great care should be exercised in protecting all water designed for drinking purposes from every possible source of contamination. Very often it is not realized with what ease water may be infected, and since it comprises such a large proportion of the weight of our daily diet the close relation of pure water to health is apparent. Nor should we forget that water is the one important article of our diet which is consumed

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[1] State Dept. Health, Lansing, Mich., Public Health Bulletin, 1910, 5(4): 187.

in the raw or natural condition; hence additional care is necessary in the bottling and vending of such a product. The ordinary methods of bottle washing as employed at the present time are totally inadequate. All bottles should be properly sterilized subsequent to washing, in order to insure freedom from dangerous organisms. Realizing that many natural waters may be polluted, either directly from farm waste or the sewage of densely populated localities or from unclean bottles, it becomes necessary to examine such products for the bacteria indicative of such pollution.

The bacteriological methods of water analysis as followed by the Bureau of Chemistry are essentially those recommended by the committee on standard methods of water analysis and adopted by the American Public Health Association on January 9, 1905.[1] Slight modifications from the original recommendations have since been made, which include the use of ox bile containing 1 per cent of peptone and 1 per cent of lactose, for the detection of *B. coli* types of organisms and streptococci. Other minor differences in the methods of procedure now used in this bureau will be mentioned under the appropriate headings.

COLLECTION, BOTTLING, AND SHIPPING OF SAMPLES.

The minimum quantity of water for making the ordinary bacteriological examination should be 2 ounces. In special cases larger quantities may be desired. Two and four ounce samples were used in conducting this investigation.

Glass-stoppered, hard, clear, white glass bottles are most satisfactory. Cork-stoppered bottles, earthen jugs, or metal containers should not be used for this purpose. These bottles should be carefully cleansed each time before using by means of a sulphuric-acid-bichromate mixture, or with alkaline permanganate followed by a mixture of oxalic and sulphuric acids, and then by a thorough rinsing with clean water. The necks and stoppers of sample bottles may be protected from dirt by tying cloth or thick paper over them before sterilization.

The writer has devised a special aluminum container to hold and protect samples, which consists of two cylindrical, threaded halves, both of which are numbered for identification and for facilitating the keeping of records. Both the bottle and the container are sterilized and not opened until the sample is collected.

Sterilization is perfected by the use of dry heat for one hour at 160° C., or in the autoclave at 115° C. for 30 minutes. Sample bottles are transported by express in a wooden shipping case specially

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[1] Report of the Committee on Standard Methods of Water Analysis to the Laboratory Section of the American Public Health Association, presented at the Habana meeting January 9, 1905. Reprinted from the Journal of Infectious Diseases, Suppl. No. 1, May, 1905.

devised by the writer. A rectangular metal case, sufficiently large to accommodate six bottles, which are held in an upright position by a removable perforated metal support, is provided with a lock and key, and is suspended within a larger wooden box having a surrounding air space of 3 inches at the top, bottom, and sides for cracked ice. The hinged lid of this box may be left unlocked for the purpose of reicing when shipments are made over long distances. The recorded temperatures of a large number of water samples, as received at the laboratory, varied from 5° to 15° C.

The following table from the committee on standard methods of water analysis[1] shows the maximum limits of time allowable after collection before making the examination:

	Hours.
Ground waters	6
Fairly pure surface water	6
Polluted surface water	6
Sewage affluents	Immediate plating.
Raw sewage	Immediate plating.

In most instances the samples herein reported were examined, either at source, or after longer intervals of time had elapsed than are allowed by the Committee, owing to the distance between the springs and the laboratory; they were, however, properly iced during this time. The temperature of the water at the time of sampling was taken in most instances.

BACTERIOLOGICAL METHODS.

In the present status of bacteriology, there is no known method by which the total number of living bacteria can be determined. The results obtained from any examination simply show the number and kind of bacteria which will develop under absolute conditions employed in making that particular analysis; but for practical purposes, the methods outlined by the committee permit the analyst to arrive at certain more or less definite results, and enable him to draw certain conclusions as to the probable purity of the water.

MEDIA EMPLOYED.

The standard medium for determining the number of bacteria in water is nutrient gelatin or agar. Owing to the amount of field work done and the polluted waters encountered, the determinations were all based on agar counts. The agar medium used in these water investigations is made from nutrient broth prepared from fresh, lean meat, Witte's peptone, and 15 grams per liter of the highest grade thread agar obtainable. Sodium chlorid is added to

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[1] This title will be subsequently designated and referred to as "Committee" without further qualification.

the agar medium, which is a variation on the recommendations of the committee. The differences between the results obtained by the use of agar containing sodium chlorid and those obtained with agar having no salt appeared, in this investigation, to be very slight, but further work is being done along this line. The reaction of the finished medium is +1 per cent to phenolphthalein. Agar medium is generally sterilized in the autoclave under 15 pounds' pressure (120° C.) for at least 15 minutes. When the intermittent method is employed, the medium is exposed on three successive days for at least 30 minutes, after the sterilizer is well filled with steam. After sterilization all media are stored in the refrigerator to prevent changes due to evaporation.

Nutrient broth is prepared in the usual manner from digested lean meat, 1 per cent peptone, and 0.5 per cent sodium chlorid; final reactions +1 per cent.

Dextrose, lactose, and saccharose media are prepared by using Liebig's beef extract as a substitute for the lean beef bouillon; the final reaction is neutral. Special sugar-free medium is obtained by inoculating the meat infusion with *B. coli.* Sterilization is accomplished by the intermittent process, except for dextrose, which is treated in the autoclave. The ox-bile medium, as recommended by Jackson and other members of the committee,[1] is now used in this laboratory as routine procedure in all fermentation tests. This consists of ordinary ox bile to which is added 1 per cent of peptone and 1 per cent of lactose, placed in fermentation tubes (inverted or old-style pattern) and sterilized. This is a very satisfactory medium.

Differential media.—Instead of lactose, or dextrose litmus agar, MacConkey's[2] bile salt agar was used for the isolation of *B. coli* like organisms. After long experience with this medium this laboratory has become familiar with various colony characteristics, and at present it does not seem desirable to change the procedure, although it is appreciated that many other workers obtain excellent results from the use of Endo's medium, litmus agar, etc. The desired result is obtained by either method employed, and the choice becomes largely a matter of personal preference due to experience with the use of certain media. Agar medium prepared from calf's liver after the same general formula as MacConkey's, but containing no added sodium tautocholate, is being experimented upon as a differential medium.

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[1] Second progress report of the Committee on Standard Methods for the Bacterial Examination of Water and Sewage. Reprinted from the American Journal of Public Hygiene, v. 20, No. 3, August, 1910.

[2]

Water (distilled)	cc..	1,000
Peptone (Witte's)	gm..	20
Lactose, c. p.	gm..	10
Agar (shredded and ground)	gm..	15
Sodium taurocholate	gm..	5

Color with neutral red, generally requiring about 5 cc of a 1 per cent solution per liter for desired tint.

Milk.—The best available milk is obtained for this medium. Certified milk is the most desirable, but it is not always obtainable. The milk is heated in the Arnold sterilizer for about 30 minutes, and then placed in the refrigerator overnight, the skim milk being removed on the following day by siphoning. Litmus milk is prepared by using a 1 per cent c. p. litmus solution. Generally about 5 cc of this 1 per cent solution to 100 cc of milk is required to give the desired shade of color.

Nitrate broth.—Dissolve 1 gram of peptone in 1 liter of water, to which add 0.2 gram of nitrate-free potassium nitrate. (The first committee report calls for 2 grams, which was evidently a mistake, and was corrected in their later report of progress.)[1] Tube and sterilize.

Indol solution is made according to the formula of Dunham, as follows: 10 grams of Witte's peptone; 5 grams of sodium chlorid; 1,000 cc of distilled water; boil, filter, tube, and sterilize.

APPARATUS.

Test tubes 150 mm in length and from 12 to 16 mm in diameter are used for ordinary work. Culture tubes of larger diameter are used for potato medium.

The fermentation tube used is the one recommended by the Committee. For presumptive fermentation tests, the small inverted, straight tube, within a larger test tube, is used instead of the regular fermentation tube. This inverted tube requires less space, is not so easily broken, and is more desirable in many respects. The petri plates used are 100 mm in diameter; the tops and the bottoms should be well matched. Pipettes of various capacities may be employed, varying from 1 to 10 cc, having an outflow not to exceed 5 seconds. The small-caliber pipettes used by chemists do not permit a flow of sufficient rapidity for bacteriological work.

All glassware should be well cleansed with suitable soap mixtures, rinsed with clean water, dried, and sterilized. Sterilization may be considered complete when glassware is exposed for one hour at 160° C., or when the cotton plugs are slightly browned.

TECHNIQUE OF PLATING.

Shake well, at least twenty-five times, the bottle containing the sample, withdraw 5 cc of the sample with a sterile pipette, and deliver 1 cc into each of two sterile petri dishes, 1 cc into a fermentation tube, and 1 cc into a small sterilized Erlenmeyer stoppered flask containing 9 cc of sterile water for a dilution of 1 to 10. Repeat this

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[1] Progress report of the Committee on Standard Methods for the Bacterial Examination of Water and Sewage. Reprinted from the American Journal of Public Hygiene, v. 18, No. 4, November, 1908.

procedure for dilutions of 1 to 100 and 1 to 1,000, the four dilutions used in making an examination of ordinary water. If the water is badly contaminated higher dilutions may be required. Melted agar kept at about 43° C. is poured into each plate containing a dilution, which plate is gently rotated and shaken so as to thoroughly mix the contents. Allow the plates to cool rapidly before incubation.

In addition to plating 1 cc, 0.1 cc, 0.01, cc, and 0.001 cc quantities in two agar plates for each dilution (one set being incubated at 25° the other at 37° C.), ox-bile fermentation tubes are also inoculated with 10 cc, 5 cc, 1 cc, 0.1 cc, 0.01 cc, and 0.001 cc, quantities, for ordinary water. Should it appear, however, that the sample was from a polluted source, the quantities used for this purpose would range from 1 cc, to 0.0001 cc, or higher dilutions as found to be necessary.

INCUBATION.

The standard methods recognize two incubation temperatures, one for gelatin at 20° C. (corresponding to room temperature), the other for agar at 37° C. (blood heat). This laboratory incubates all plate cultures for from three to four days, when the maximum number of colonies appears before making final counts.

TESTS FOR B. COLI.

From the ox-bile fermentation tubes showing the presence of gas-producing organisms in the two highest dilutions, plate cultures are made on the MacConkey's bile salt agar for the isolation of pure cultures. Generally five plates are prepared from each fermentation tube by using a single platinum loop-full of the mixed culture, then, without flaming the needle during the interval, five dilutions are made by passing the needle from one tube to another of the melted agar held at about 43° C. The tubes are agitated and the contents poured into five sterile plates. These plate cultures should be made within 24 to 36 hours after the appearance of gas, since the organisms are then most active and more easily developed. Difficulty may be experienced in recovering *B. coli* in old sugar cultures unless they are rejuvenated. Often pure cultures of *B. coli* develop from the ox-bile fermentation tubes. The presence of gas in the ox-bile tubes is considered as only a presumptive test for *B. coli.*

DIAGNOSTIC CHARACTERS.

The tests for *B. coli* are considered positive only when the organism possesses the following characteristics:

(1) *Morphology typical.*—Non-spore-bearing bacillus, relatively small and thick, with rounded ends. The size, arrangement, and form may vary slightly according to the age of the culture and the medium employed. Atypical forms under abnormal conditions may develop typical types under favorable circumstances.

(2) *Motility.*—Young agar, broth, or gelatin cultures should be examined. Abnormal conditions may cause non-motility, but when rejuvenated motility may develop.

(3) *Non-liquefaction of gelatin.*—Gelatin cultures are allowed to stand one month, if possible, before recording final results. *B. colacæ* generally liquefies gelatin only after several days' growth.

(4) *Fermentation of dextrose.*—Broth showing from 30 to 70 per cent gas, with a carbon dioxid ratio to hydrogen as 1 is to 2. Mixed cultures of *B. coli* and other organisms may give wide variations in the volume and quality of gas produced, but in pure cultures this organism usually gives fairly uniform results.

(5) *Coagulation of milk.*—With acid production this is essential, and usually occurs within 48 hours at 37° C. Boiling may be necessary with certain strains to produce curding.

(6) *Indol production.*—In nearly every instance the test is positive, varying from a trace to marked reactions.

(7) *Nitrate reductions.*—Same as for indol.

In addition to the recommendations of the committee, the following test is made in this laboratory:

Gram-stain.—Negative for *B. coli.* Additional culture media used consist of potato, bouillon, and slant agar. These are used in routine practice, but not considered essential.

QUANTITIES OF WATER TESTED FOR B. COLI.

For ordinary water use 10 cc, 5 cc, 1 cc, 0.1 cc, 0.01 cc, and 0.001 cc, quantities which are inoculated into the bile fermentation tubes. Dextrose tubes may be used as duplicates. They may or may not give higher results than the bile medium, perhaps depending on the virility of the organisms. With water thought to be polluted, the quantities used vary in tenfold ratio from 1 cc to 0.0001 cc or higher, according to the probable degree of contamination.

STREPTOCOCCI DETERMINATIONS.

The physical character of the fermentation tubes is noted, and smear preparations from each tube showing visible growth are made, stained, and examined microscopically for the presence of streptococci. Only typical chains with unmistakable morphology are considered positive for streptococci. This test is considered valuable in substantiating the results obtained from the test for *B. coli* as an index of pollution. Water is never condemned on the streptococci findings alone, these results being considered only in connection with the number of *B. coli* present.

INTERPRETATION OF RESULTS.

In determining the purity of a drinking water all the available information concerning its history should be taken into consideration. When possible a chemical examination should be made to substantiate conclusions based on the bacteriological findings. It is also desirable to have a thorough inspection made of the source of the water in question. In the case of a spring or well the possibilities of immediate contamination from the surface should be realized. The season of the year, climatic conditions, and similar factors may constitute valuable data in considering the interpretation of results.

It is often necessary to pass upon the quality of a water without having a complete history of the product at hand. In such instances one should be more conservative in his views than when the desired information is available. In cases of this character the merits of the individual water must be considered on the results of the analysis alone. In general, it is believed that all waters intended for drinking purposes which show the presence of *B. coli* in a majority of the 1 cc samples should be considered as being seriously polluted and unfit for human consumption; but this standard is to be considered in connection with inspection of source of supply when this is possible.

DETAILED STATEMENT OF RESULTS.

MAINE.

GLENWOOD SPRING.

(Alkaline.)

Misc. Div. No. 2149.

Chemical analysis.

Constituents.	Examination by Bureau of Chemistry.			Advertised analysis.
	Amount of water used for each determination.	Analysis.	Total inorganic material in solution.	
Ions.	*Grams.*	*Parts per million.*	*Per cent.*	*Parts per million.*
Phosphoric acid (PO_4)	500	0.00		
Metaboric acid (BO_2)	1,000	.00		
Arsenic acid (AsO_4)	1,000	.00		
Silica (SiO_2)	500	11.00	11.76	
Sulphuric acid (SO_4)	2,000	3.62	3.87	
Carbonic acid (CO_3)	100	.00		
Bicarbonic acid (HCO_3)	100	54.71	58.49	
Nitric acid (NO_3)	100	1.55	1.66	
Nitrous acid (NO_2)	50	.00		
Chlorin (Cl)	500	1.80	1.92	
Bromin (Br)	1,000	.00		
Iodin (I)	1,000	.00		
Iron (Fe) Aluminum (Al)	2,000	.35	.37	
Manganese (Mn)	2,000	.00		
Calcium (Ca)	1,000	13.01	13.92	
Magnesium (Mg)	1,000	2.49	2.66	
Potassium (K)	2,000	.93	.99	
Sodium (Na)	2,000	3.92	4.19	
Lithium (Li)	2,000	.00		
Ammonium (NH_4)	500	.01	.01	
Oxygen (calculated) (O)		.15	.16	
Total		93.54	100.00	
Hypothetical Combinations.				
Ammonium chlorid (NH_4Cl)		.03	.03	
Lithium chlorid (LiCl)				
Potassium chlorid (KCl)		1.77	1.89	
Potassium bromid (KBr)				
Potassium sulphate (K_2SO_4)				
Sodium nitrate ($NaNO_3$)		2.12	2.27	
Sodium nitrite ($NaNO_2$)				
Sodium chlorid (NaCl)		1.57	1.68	
Sodium sulphate (Na_2SO_4)		5.34	5.71	
Sodium bicarbonate ($NaHCO_3$)		3.65	3.90	
Sodium metaborate ($NaBO_2$)				
Magnesium chlorid ($MgCl_2$)				
Magnesium bicarbonate ($Mg(HCO_3)_2$)		14.96	15.99	
Calcium chlorid ($CaCl_2$)				
Calcium sulphate ($CaSO_4$)				
Calcium bicarbonate ($Ca(HCO_3)_2$)		52.60	56.23	
Calcium phosphate ($Ca_3(PO_4)_2$)				
Ferric oxid (Fe_2O_3) Alumina (Al_2O_3)		.50	.54	
Ferrous bicarbonate ($Fe(HCO_3)_2$)				
Calcium silicate ($CaSiO_3$)				
Silica (SiO_2)		11.00	11.76	
Total		93.54	100.00	

MAINE.

GLENWOOD SPRING.

Misc. Div. No. 2149.

Gases.[1]

	cc
Carbon dioxid (free)	7.3
Carbon dioxid (set free from bicarbonate upon evaporating to dryness)	10.0
Hydrogen sulphid	.0

Sanitary analysis.

	Parts per million.
Ammonia, free	0.010
Ammonia albuminoid	.010
Nitrogen as nitrites	.000
Nitrogen as nitrates	.350
Oxygen required	5.000
Bacteriological data:	
Organisms per cc on plain agar after 48 hours at 37° C	6
Organisms per cc on neutral red agar after 48 hours at 37° C	3
Gas-forming organisms in 5 cc	.....
Gas-forming organisms in 1 cc	0
Gas-forming organisms in 0.1 cc	0
Gas-forming organisms in 0.01 cc	.....

Glenwood spring is situated in St. Albans, Somerset County, Me., and is owned by Dr. C. O. Moulton, of Hartland, Me. The spring has a flow of approximately 30 gallons per minute and at the time of inspection, November 15, 1907, the temperature of the water was 48° F. Samples were taken directly from source for examination. Chemical analysis shows this to be a moderately mineralized, calcic, bicarbonated water of the alkaline type. The hypothetical combination indicates that approximately 76 per cent of the salts in solution are in the form of the bicarbonates of calcium, magnesium, and sodium, and approximately 6 per cent of sulphate of sodium. The sanitary analysis shows a small amount of free and albuminoid ammonia, and low nitrates and a low bacterial count, which indicates organic purity. Inspection of the premises failed to reveal any probable sources of pollution. No satisfactory comparison could be made with the advertised analysis, as the latter is very incomplete, and it therefore has been omitted.

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[1] At 0° C. and 760 mm pressure in 1,000 cc of water.

MAINE.

HIGHLAND SPRING.

(Alkaline.)

Misc. Div. No. 2142.

Chemical analysis.

Constituents.	Examination by Bureau of Chemistry.			Advertised analysis.
	Amount of water used for each determination.	Analysis.	Total inorganic material in solution.	
IONS.	*Grams.*	*Parts per million.*	*Per cent.*	*Parts per million.*
Phosphoric acid (PO_4)	500	0.00		
Metaboric acid (BO_2)	1,000	.00		
Arsenic acid (AsO_4)	1,000	.00		
Silica (SiO_2)	500	11.40	21.78	
Sulphuric acid (SO_4)	2,000	4.65	8.89	
Carbonic acid (CO_3)	100	.00		
Bicarbonic acid (HCO_3)	100	22.90	43.77	
Nitric acid (NO_3)	100	Traces.		
Nitrous acid (NO_2)	50	.00		
Chlorin (Cl)	500	2.20	4.21	
Bromin (Br)	1,000	.00		
Iodin (I)	1,000	.00		
Iron (Fe) Aluminum (Al)	2,000	.35	.67	
Manganese (Mn)	2,000	.00		
Calcium (Ca)	1,000	5.86	11.20	
Magnesium (Mg)	1,000	.94	1.79	
Potassium (K)	2,000	1.21	2.31	
Sodium (Na)	2,000	2.79	5.33	
Lithium (Li)	2,000	.00		
Ammonium (NH_4)	500	.021	.04	
Oxygen (calculated) (O)				
Total		52.321	100.00	
HYPOTHETICAL COMBINATIONS.				
Ammonium chlorid (NH_4Cl)		.061	.12	
Lithium chlorid (LiCl)		.00		
Potassium chlorid (KCl)		2.30	4.40	
Potassium bromid (KBr)				
Potassium sulphate (K_2SO_4)				
Sodium nitrate ($NaNO_3$)		Trace.		
Sodium nitrite ($NaNO_2$)				
Sodium chlorid (NaCl)		1.77	3.38	
Sodium sulphate (Na_2SO_4)		6.44	12.31	
Sodium bicarbonate ($NaHCO_3$)				
Magnesium sulphate ($MgSO_4$)		.38	.73	
Magnesium chlorid ($MgCl_2$)				
Magnesium bicarbonate ($Mg(HCO_3)_2$)		5.17	9.88	
Calcium chlorid ($CaCl_2$)				
Calcium sulphate ($CaSO_4$)				
Calcium bicarbonate ($Ca(HCO_3)_2$)		23.69	45.27	
Calcium phosphate ($Ca_3(PO_4)_2$)				
Ferric oxid (Fe_2O_3)				
Alumina (Al_2O_3)				
Ferrous bicarbonate ($Fe(HCO_3)_2$)		1.11	2.12	
Calcium silicate ($CaSiO_3$)				
Silica (SiO_2)		11.40	21.79	
Total		52.321	100.00	

MAINE.

HIGHLAND SPRING.

Misc. Div. No. 2142.

Gases.[1]

	cc
Carbon dioxid (free)	38.2
Carbon dioxid (set free from bicarbonate upon evaporating to dryness)	4.2
Hydrogen sulphid	.0

Sanitary analysis.

	Parts per million.
Ammonia, free	0.02
Ammonia albuminoid	.05
Nitrogen as nitrites	.00
Nitrogen as nitrates	Tr.
Oxygen required	1.50
Bacteriological data:	
Organisms per cc on plain agar after 48 hours at 37° C	0
Organisms per cc on neutral red agar after 48 hours at 37° C	0
Gas-forming organisms in 5 cc	....
Gas-forming organisms in 1 cc	0
Gas-forming organisms in 0.1 cc	0
Gas-forming organisms in 0.01 cc	....

Highland Spring is located at Lewiston, Me., and is owned and operated by the Highland Spring Water Co., 406 West Forty-fifth Street, New York. The spring was inspected November 19, 1907, and samples obtained directly from source for the purpose of examination. Chemical analysis shows this to be a lightly mineralized, calcic, bicarbonate, water of the alkaline type. The hypothetical combination indicates that approximately 55 per cent of the salts in solution are in the form of bicarbonates of calcium and magnesium and approximately 12 per cent sulphate of sodium. Sanitary analysis shows small quantities of free and albuminoid ammonia, only a trace of nitrates, and an absence of bacteria, which is indicative of organic purity. No previous analysis of this water could be obtained for purposes of comparison.

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[1] At 0° C. and 760 mm pressure in 1,000 cc of water.

MAINE.

KEYSTONE MINERAL SPRING.

(Alkaline.)

Misc. Div. No. 2144.

Chemical analysis.

Constituents.	Examination by Bureau of Chemistry.			Advertised analysis.
	Amount of water used for each determination.	Analysis.	Total inorganic material in solution.	
IONS.	*Grams.*	*Parts per million.*	*Per cent.*	*Parts per million.*
Phosphoric acid (PO_4)	500	0.00		
Metaboric acid (BO_2)	1,000	.00		
Arsenic acid (AsO_4)	1,000	.00		
Silica (SiO_2)	500	11.60	11.16	
Sulphuric acid (SO_4)	2,000	3.43	3.30	
Carbonic acid (CO_3)	100	.00		
Bicarbonic acid (HCO_3)	100	59.53	57.30	
Nitric acid (NO_3)	100	.88	.85	
Nitrous acid (NO_2)	50	.00		
Chlorin (Cl)	500	5.20	5.00	
Bromin (Br)	1,000	.00		
Iodin (I)	1,000	.00		
Iron (Fe)	2,000	.39	.37	
Aluminum (Al)				
Manganese (Mn)	2,000	.00		
Calcium (Ca)	1,000	14.72	14.16	
Magnesium (Mg)	1,000	3.11	2.99	
Potassium (K)	2,000	.84	.80	
Sodium (Na)	2,000	4.23	4.07	
Lithium (Li)	2,000	.00		
Ammonium (NH_4)	500	.00		
Oxygen (calculated) (O)				
Total		103.93	100.00	
HYPOTHETICAL COMBINATIONS.				
Ammonium chlorid (NH_4Cl)		.00		
Lithium chlorid (LiCl)		.00		
Potassium chlorid (KCl)		1.60	1.54	
Potassium bromid (KBr)				
Potassium sulphate (K_2SO_4)				
Sodium nitrate ($NaNO_3$)		1.20	1.15	
Sodium nitrite ($NaNO_2$)				
Sodium chlorid (NaCl)		7.33	7.05	
Sodium sulphate (Na_2SO_4)		3.14	3.02	
Sodium bicarbonate ($NaHCO_3$)				
Magnesium sulphate ($MgSO_4$)		1.64	1.58	
Magnesium chlorid ($MgCl_2$)				
Magnesium bicarbonate ($Mg(HCO_3)_2$)		16.68	16.05	
Calcium chlorid ($CaCl_2$)				
Calcium sulphate ($CaSO_4$)				
Calcium bicarbonate ($Ca(HCO_3)_2$)		59.50	57.26	
Calcium phosphate ($Ca_3(PO_4)_2$)				
Ferric oxid (Fe_2O_3)				
Alumina (Al_2O_3)				
Ferrous bicarbonate ($Fe(HCO_3)_2$)		1.24	1.19	
Calcium silicate ($CaSiO_3$)				
Silica (SiO_2)		11.60	11.16	
Total		103.93	100.00	

MAINE.

KEYSTONE MINERAL SPRING.

Misc. Div. No. 2144.

Gases.[1]

	cc
Carbon dioxid (free)	9. 2
Carbon dioxid (set free from bicarbonate upon evaporating to dryness)	10. 9
Hydrogen sulphid	. 0

Sanitary analysis.

	Parts per million.
Ammonia, free	0. 00
Ammonia albuminoid	. 00
Nitrogen as nitrites	. 00
Nitrogen as nitrates	. 20
Oxygen required	6. 50
Bacteriological data:	
Organisms per cc on plain agar after 48 hours at 37° C	2
Organisms per cc on neutral red agar after 48 hours at 37° C	2
Gas-forming organisms in 5 cc	....
Gas-forming organisms in 1 cc	0
Gas-forming organisms in 0.1 cc	0
Gas-forming organisms in 0.01 cc	....

Keystone Mineral Spring is located in East Poland, Me., and is owned and operated by E. H. Pratt. The spring was inspected on November 19, 1907, and samples taken from source for examination. The flow was from 5 to 6 gallons per minute. Chemical analysis shows this to be a moderately mineralized, calcic, bicarbonate water of the alkaline type. The hypothetical combination indicates that approximately 73 per cent of the salts in solution are in the form of bicarbonates of calcium and magnesium, with 7 per cent of sodium chlorid and 3 per cent of sodium sulphate. The sanitary analysis shows an absence of free and albuminoid ammonia, and low nitrates, which, with a low bacterial count, indicates organic purity. The advertised analysis of this water is not reported in sufficient detail for use in comparison with these results.

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[1] At 0° C. and 760 mm pressure in 1,000 cc of water.

MAINE.

MOUNT HARTFORD LITHIA SPRING.

Alkaline.

Misc. Div. No. 2146.

Chemical analysis.

Constituents.	Examination by Bureau of Chemistry.			Advertised analysis.
	Amount of water used for each determination.	Analysis.	Total inorganic material in solution.	
IONS.	*Grams.*	*Parts per million.*	*Per cent.*	*Parts per million.*
Phosphoric acid (PO_4)	500	0. 00		0. 02
Metaboric acid (BO_2)	1, 000	. 00		
Arsenic acid (AsO_4)	1, 000	. 00		
Silica (SiO_2)	500	9. 00	19. 50	11. 05
Sulphuric acid (SO_4)	2, 000	1. 62	3. 51	3. 93
Carbonic acid (CO_3)	100	. 00		
Bicarbonic acid (HCO_3)	100	20. 47	44. 36	18. 58
Nitric acid (NO_3)	100	. 88	1. 91	. 89
Nitrous acid (NO_2)	50	. 00		
Chlorin (Cl)	100	4. 00	8. 67	1. 08
Bromin (Br)	1, 000	. 00		
Iodin (I)	1, 000	. 00		
Iron (Fe)	2, 000	Trace.		. 37
Aluminum (Al)				. 12
Manganese (Mn)	2, 000	. 00		. 05
Calcium (Ca)	1, 000	4. 43	9. 61	3. 24
Magnesium (Mg)	1, 000	1. 03	2. 23	. 73
Potassium (K)	2, 000	. 76	1. 65	. 64
Sodium (Na)	2, 000	3. 95	8. 56	4. 41
Lithium (Li)	2, 000	. 00		. 01
Ammonium (NH_4)	500	Trace.		Trace.
Oxygen (calculated) (O)				. 28
Rubidium (Rb)				Trace.
Strontium (Sr)				. 04
Total		46. 14	100. 00	45. 44
HYPOTHETICAL COMBINATIONS.				
Ammonium chlorid (NH_4Cl)		Trace.		Trace.
Lithium chlorid (LiCl)		. 00		. 06
Potassium chlorid (KCl)		1. 44	3. 12	1. 22
Rubidium chlorid (RbCl)				Trace.
Potassium sulphate (K_2SO_4)				
Sodium nitrate ($NaNO_3$)		1. 20	2. 60	1. 22
Sodium nitrite ($NaNO_2$)				
Sodium chlorid (NaCl)		5. 48	11. 88	. 74
Sodium sulphate (Na_2SO_4)		2. 40	5. 20	5. 82
Sodium bicarbonate ($NaHCO_3$)		2. 52	5. 46	6. 93
Sodium metaborate ($NaBO_2$)				
Magnesium chlorid ($MgCl_2$)				
Magnesium bicarbonate ($Mg(HCO_3)_2$)		6. 19	13. 42	4. 39
Calcium chlorid ($CaCl_2$)				
Strontium bicarbonate ($Sr(HCO_3)_2$)				. 10
Calcium bicarbonate ($Ca(HCO_3)_2$)		17. 91	38. 82	13. 06
Calcium phosphate ($Ca_3(PO_4)_2$)				. 03
Ferric oxid (Fe_2O_3)		Trace.		. 53
Alumina (Al_2O_3)				. 22
Ferrous bicarbonate ($Fe(HCO_3)_2$)				
Tri-manganese tetroxid (Mn_3O_4)				. 07
Silica (SiO_2)		9. 00	19. 50	11. 05
Total		46. 14	100. 00	45. 44

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[1] Made by J. W. Mallet, University of Virginia. · For purposes of comparison, recalculated from original data according to the scheme adopted by the Bureau of Chemistry.

MAINE.

MOUNT HARTFORD LITHIA SPRING.

Misc. Div. No. 2146.

Gases.[1]

	cc
Carbon dioxid (free)	2. 2
Carbon dioxid (set free from bicarbonate upon evaporating to dryness)	3. 8
Hydrogen sulphid	. 0

Sanitary analysis.

	Parts per million.
Ammonia, free	Trace.
Ammonia albuminoid	Trace.
Nitrogen as nitrites	0. 0
Nitrogen as nitrates	. 2
Oxygen required	8. 0
Bacteriological data:	
Organisms per cc on plain agar after 48 hours at 37° C	2
Organisms per cc on neutral red agar after 48 hours at 37° C	0
Gas-forming organisms in 5 cc	......
Gas-forming organisms in 1 cc	0
Gas-forming organisms in 0.1 cc	0
Gas-forming organisms in 0.01 cc	......

Mount Hartford Lithia Spring is located at Hartford, Oxford County, Me. The property being in litigation at the time of inspection, November 18, 1907, the name of the owner could not be learned. Shinn & Co. (Inc.) are the selling agents. The spring had a flow of approximately 10 gallons per minute, with a temperature of 48° F., and samples for analysis were obtained from a lead pipe connected with the spring. Chemical analysis shows this to be a lightly mineralized, calcic, sodic, bicarbonated water of the alkaline type. The hypothetical combination indicates that approximately 58 per cent of the salts in solution are in the form of the bicarbonates of calcium, magnesium, and sodium, with 12 per cent of sodium chlorid and 5 per cent of sodium sulphate. The sanitary analysis shows the presence of only traces of free and albuminoid ammonia, low nitrates, and a low bacterial count which is indicative of organic purity. The advertised analysis made in 1898 is in very close agreement with that here given. Inspection of the premises failed to reveal any probable sources of pollution.

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[1] At 0° C. and 760 mm pressure in 1,000 cc of water.

MAINE.

OAK GROVE SPRING.

(Alkaline.)

Misc. Div. No. 2148.

Chemical analysis.

Constituents.	Examination by Bureau of Chemistry.			Advertised analysis.
	Amount of water used for each determination.	Analysis.	Total inorganic material in solution.	
IONS.	*Grams.*	*Parts per million.*	*Per cent.*	*Parts per million.*
Phosphoric acid (PO_4)	500	0.00		
Metaboric acid (BO_2)	1,000	.00		
Arsenic acid (AsO_4)	1,000	.00		
Silica (SiO_2)	500	15.50	11.49	
Sulphuric acid (SO_4)	2,000	4.94	3.66	
Carbonic acid (CO_3)	100	.00		
Bicarbonic acid (HCO_3)	100	73.03	54.17	
Nitric acid (NO_3)	100	5.30	3.93	
Nitrous acid (NO_2)	50	Ft. tr.		
Chlorin (Cl)	500	5.60	4.15	
Bromin (Br)	1,000	.00		
Iodin (I)	1,000	.00		
Iron (Fe) Aluminum (Al)	2,000	.25	.18	
Manganese (Mn)	2,000	.00		
Calcium (Ca)	1,000	18.58	13.79	
Magnesium (Mg)	1,000	3.50	2.59	
Potassium (K)	2,000	1.10	.82	
Sodium (Na)	2,000	6.95	5.15	
Lithium (Li)	2,000	.00		
Ammonium (NH_4)	500	Trace.		
Oxygen (calculated) (O)		.10	.07	
Total		134.85	100.00	
HYPOTHETICAL COMBINATIONS.				
Ammonium chlorid (NH_4Cl)		Traces.		
Lithium chlorid (LiCl)				
Potassium chlorid (KCl)		2.10	1.56	
Potassium bromid (KBr)				
Potassium sulphate (K_2SO_4)				
Sodium nitrate ($NaNO_3$)		7.25	5.38	
Sodium nitrate ($NaNO_2$)		Ft. tr.		
Sodium chlorid (NaCl)		7.60	5.63	
Sodium sulphate (Na_2SO_4)		6.17	4.59	
Sodium bicarbonate ($NaHCO_3$)				
Sodium metaborate ($NaBO_2$)				
Magnesium sulphate ($MgSO_4$)		.97	.72	
Magnesium bicarbonate ($Mg(HCO_3)_2$)		19.80	14.68	
Calcium chlorid ($CaCl_2$)				
Calcium sulphate ($CaSO_4$)				
Calcium bicarbonate ($Ca(HCO_3)_2$)		75.11	55.69	
Calcium phosphate ($Ca_3(PO_4)_2$)				
Ferric oxid (Fe_2O_3) Alumina (Al_2O_3)		.35	.26	
Ferrous bicarbonate ($Fe(HCO_3)_2$)				
Calcium silicate ($CaSiO_3$)				
Silica (SiO_2)		15.50	11.49	
Total		134.85	100.00	

MAINE.

OAK GROVE SPRING.

Misc. Div. No. 2148.

Gases.[1]

	cc
Carbon dioxid (free)	9.0
Carbon dioxid (set free from bicarbonate upon evaporating to dryness)	13.4
Hydrogen sulphid	.0

Sanitary analysis.

	Parts per million.
Ammonia, free	Trace.
Ammonia albuminoid	Trace.
Nitrogen as nitrites	Ft. tr.
Nitrogen as nitrates	1.2
Oxygen required	4.0
Bacteriological data:	
Organisms per cc on plain agar after 48 hours at 37° C	70.0
Organisms per cc on neutral red agar after 48 hours at 37° C	11.0
Gas-forming organisms in 5 cc	......
Gas-forming organisms in 1 cc	+
Gas-forming organisms in 0.1 cc	0
Gas-forming organisms in 0.01 cc	......

Oak Grove Spring is located at Brewer, Penobscot County, Me., and is owned and operated by E. H. Homestead. This spring was visited November 15, 1907, and samples directly from source were obtained for examination. The flow was approximately 150 gallons per hour, the temperature being 48° F. Chemical analysis shows this to be a moderately mineralized, calcic, bicarbonated water of the alkaline type. The hypothetical combination indicates that approximately 70 per cent of the salts in solution are in the form of the bicarbonates of calcium and magnesium, with 5 per cent of potassium sulphate, 6 per cent of sodium chlorid, and 5 per cent of sodium sulphate. The sanitary analysis shows traces of ammonia, faint traces of nitrites, and a small amount of nitrates. The bacterial count is low; gas-forming organisms are found in 1 cc of water. Inspection of the premises failed to reveal any probable sources of pollution. No previous analysis of this water could be obtained for purposes of comparison.

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[1] At 0° C. and 760 mm pressure in 1,000 cc of water.

MAINE.

PINE SPRING.

(Alkaline-saline.)

Misc. Div. No. 2143.

Chemical analysis.

Constituents.	Examination by Bureau of Chemistry.			Advertised analysis.[1]
	Amount of water used for each determination.	Analysis.	Total inorganic material in solution.	
IONS.	*Grams.*	*Parts per million.*	*Per cent.*	*Parts per million.*
Phosphoric acid (PO_4)	500	0.00		
Metaboric acid (BO_2)	1,000	.00		
Arsenic acid (AsO_4)	1,000	.00		
Silica (SiO_2)	500	7.40	22.51	7.98
Sulphuric acid (SO_4)	2,000	1.05	3.19	.39
Carbonic acid (CO_3)	100	.00		
Bicarbonic acid (HCO_3)	100	12.86	39.12	9.24
Nitric acid (NO_3)	100	.00		
Nitrous acid (NO_2)	50	Ft. tr.		
Chlorin (Cl)	500	4.20	12.78	3.87
Bromin (Br)	1,000	.00		
Iodin (I)	1,000	.00		
Iron (Fe) Aluminum (Al)	2,000	.32	.97	.57
Manganese (Mn)	2,000	.00		
Calcium (Ca)	1,000	2.14	6.51	1.87
Magnesium (Mg)	1,000	.79	2.40	.05
Potassium (K)	2,000	.60	1.83	3.48
Sodium (Na)	2,000	3.49	10.61	
Lithium (Li)	2,000	.00		
Ammonium (NH_4)	500	.03	.08	
Oxygen (calculated) (O)				
Total		32.88	100.00	27.45
HYPOTHETICAL COMBINATIONS.				
Ammonium chlorid (NH_4Cl)		.08	.23	
Lithium chlorid (LiCl)		.00		
Potassium chlorid (KCl)		1.14	3.47	
Potassium bromid (KBr)				
Potassium sulphate (K_2SO_4)				
Sodium nitrate ($NaNO_3$)				
Sodium nitrate ($NaNO_2$)				
Sodium chlorid (NaCl)		5.96	18.13	6.38 +KCl
Sodium sulphate (Na_2SO_4)		1.55	4.71	.58
Sodium bicarbonate ($NaHCO_3$)		2.33	7.09	2.84
Sodium metaborate ($NaBO_2$)				
Magnesium chlorid ($MgCl_2$)				
Magnesium bicarbonate ($Mg(HCO_3)_2$)		4.75	14.45	.30
Calcium chlorid ($CaCl_2$)				
Calcium sulphate ($CaSO_4$)				
Calcium bicarbonate ($Ca(HCO_3)_2$)		8.65	26.31	7.56
Calcium phosphate ($Ca_3(PO_4)_2$)				
Ferric oxid (Fe_2O_3)				
Alumina (Al_2O_3)				
Ferrous bicarbonate ($Fe(HCO_3)_2$)		1.02	3.10	1.81
Calcium silicate ($CaSiO_3$)				
Silica (SiO_2)		7.40	22.51	7.98
Total		32.88	100.00	27.45

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[1] By Prof. F. C. Robinson, of Bowdoin College (no date); for purposes of comparison, recalculated from original data according to the scheme adopted by the Bureau of Chemistry.

MAINE.

PINE SPRING.

Misc. Div. No. 2143.

Gases.[1]

	cc
Carbon dioxid (free)	8.2
Carbon dioxid (set free from bicarbonate upon evaporating to dryness)	2.4
Hydrogen sulphid	.0

Sanitary analysis.

	Parts per million.
Ammonia, free	0.025
Ammonia albuminoid	.005
Nitrogen as nitrites	Ft. tr.
Nitrogen as nitrates	Trace.
Oxygen required	6.000
Bacteriological data:	
Organisms per cc on plain agar after 48 hours at 37° C	2
Organisms per cc on neutral red agar after 48 hours at 37° C	0
Gas-forming organisms in 5 cc	......
Gas-forming organisms in 1 cc	0
Gas-forming organisms in 0.1 cc	0
Gas-forming organisms in 0.01 cc	......

Pine Spring is situated in Topham, Sagadahoc County, Me., and is owned and operated by the Pine Spring Water Co. It was inspected November 17, 1907, samples for examination being obtained from a galvanized-iron pipe connected with the spring. It has a flow of approximately 5 gallons per minute and a temperature of 46° F. The chemical analysis shows this to be a very lightly mineralized, sodic, calcic, muriated, bicarbonated water of the alkaline-saline type. The hypothetical combination indicates that approximately 48 per cent of the salts in solution are in the form of the bicarbonates of calcium, magnesium, and sodium, with 18 per cent of sodium chlorid and 5 per cent of sodium sulphate. The sanitary analysis shows small quantities of free and albuminoid ammonia, faint traces of nitrites, and a trace of nitrates with a low bacterial count which indicates organic purity. Inspection of the premises failed to reveal any probable sources of pollution. The advertised analysis is in very close agreement with that made in this bureau.

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[1] At 0° C. and 760 mm pressure in 1,000 cc of water.

MAINE.

POLAND MINERAL SPRING.

Alkaline.

Misc. Div. No. 2145.

Chemical analysis.

Constituents.	Examination by Bureau of Chemistry.			Advertised analysis[1]
	Amount of water used for each determination.	Analysis.	Total inorganic material in solution.	
Ions.	*Grams.*	*Parts per million.*	*Per cent.*	*Parts per million.*
Phosphoric acid (PO_4)	500	Traces.		
Metaboric acid (BO_2)	1,000	0.000		
Arsenic acid (AsO_4)	1,000	.000		
Silica (SiO_2)	500	15.400	14.17	19.26
Sulphuric acid (SO_4)	2,000	3.290	3.03	1.48
Carbonic acid (CO_3)	100	.000		
Bicarbonic acid (HCO_3)	100	55.630	51.19	36.64
Nitric acid (NO_3)	100	3.988	3.67	5.30
Nitrous acid (NO_2)	50	.000		.00
Chlorin (Cl)	500	5.900	5.43	2.75
Bromin (Br)	1,000	.000		
Iodin (I)	1,000	.000		
Iron (Fe) Aluminum (Al)	2,000	.320	.29	
Manganese (Mn)	2,000	.000		
Calcium (Ca)	1,000	14.370	13.23	8.47
Magnesium (Mg)	1,000	2.380	2.19	2.69
Potassium (K)	2,000	.900	.83	1.21
Sodium (Na)	2,000	6.340	5.84	2.78
Lithium (Li)	2,000	.000		
Ammonium (NH_4)	500	.011	.01	.01
Oxygen (calculated) (O)		.130	.12	
Total		108.651	100.00	80.59
Hypothetical Combinations.				
Ammonium chlorid (NH_4Cl)		.031	.03	.03
Lithium chlorid (LiCl)				
Potassium chlorid (KCl)		1.720	1.58	2.31
Potassium bromid (KBr)				
Potassium sulphate (K_2SO_4)				
Sodium nitrate ($NaNO_3$)		5.450	5.02	7.27
Sodium nitrite ($NaNO_2$)				
Sodium chlorid (NaCl)		8.350	7.68	2.06
Sodium sulphate (Na_2SO_4)		4.870	4.48	
Sodium bicarbonate ($NaHCO_3$)				
Sodium metaborate ($NaBO_2$)				
Magnesium chlorid ($MgCl_2$)				.54
Magnesium bicarbonate ($Mg(HCO_3)_2$)		14.290	13.15	13.02
Magnesium sulphate ($MgSO_4$)				1.86
Calcium sulphate ($CaSO_4$)				
Calcium bicarbonate ($Ca(HCO_3)_2$)		58.090	53.48	34.24
Calcium phosphate ($Ca_3(PO_4)_2$)				
Ferric oxid (Fe_2O_3) Alumina (Al_2O_3)		.450	.41	Trace.
Ferrous bicarbonate ($Fe(HCO_3)_2$)				
Calcium silicate ($CaSiO_3$)				
Silica (SiO_2)		15.400	14.17	19.26
Total		108.651	100.00	80.59

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[1] Data compiled from a published mineral analysis by C. F. Chandler (1875), and from a published sanitary analysis by A. A. Breneman (1903); recalculated for purposes of comparison from original data according to the scheme adopted by the Bureau of Chemistry.

MAINE.

POLAND MINERAL SPRING.

Misc. Div. No. 2145.

Gases.[1]

	cc
Carbon dioxid (free)	2. 1
Carbon dioxid (set free from bicarbonate upon evaporation to dryness)	10. 2
Hydrogen sulphid	. 0

Sanitary analysis.

	Parts per million.
Ammonia, free	0. 010
Ammonia albuminoid	. 005
Nitrogen as nitrites	. 000
Nitrogen as nitrates	. 900
Oxygen required	4. 000
Bacteriological data:	
Organisms per cc on plain agar after 48 hours at 37° C	11
Organisms per cc on neutral red agar after 48 hours at 37° C	8
Gas-forming organisms in 5 cc	......
Gas-forming organisms in 1 cc	0
Gas-forming organisms in 0.1 cc	0
Gas-forming organisms in 0.01 cc	......

The Poland Mineral Spring is located in South Poland, Me., and is owned and operated by the firm of Hiram Ricker & Sons. The waters from this spring have been sold for many years, the spring having had considerable local reputation as early as 1860. The water is used locally and a large quantity is bottled for sale. The spring was visited on November 15, 1907, samples directly from source being obtained for examination. The flow at the time of inspection was approximately 7 gallons per minute, with a temperature of 46° F. The chemical analysis shows this to be a moderately mineralized, calcic, bicarbonated water of the alkaline type. The hypothetical combination indicates that approximately 67 per cent of the salts in solution are in the form of bicarbonates of calcium and magnesium with 8 per cent of sodium chlorid, 5 per cent of sodium nitrate, and 4 per cent of sodium sulphate. The sanitary analysis shows small amounts of free and albuminoid ammonia, low nitrates, and low bacterial count, which indicates organic purity. Inspection of the premises failed to reveal any probable sources of pollution. The advertised analysis differs somewhat from the analysis made in this bureau, the mineralization of the spring having apparently increased since the advertised analysis was made in 1875.

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[1] At 0° C. and 760 mm pressure in 1,000 cc of water.

MAINE.

ROCKY HILL SPRING.

(Alkaline.)

Misc. Div. No. 2147.

Chemical analysis.

Constituents.	Examination by Bureau of Chemistry.			Advertised analysis.[1]
	Amount of water used for each determination.	Analysis.	Total inorganic material in solution.	
IONS.	*Grams.*	*Parts per million.*	*Per cent*	*Parts per million.*
Phosphoric acid (PO_4)	500	0.00		
Metaboric acid (BO_2)	1,000	.00		
Arsenic acid (AsO_4)	1,000	.00		
Silica (SiO_2)	500	10.60	9.99	11.06
Sulphuric acid (SO_4)	2,000	3.66	3.45	2.88
Carbonic acid (CO_3)	100	.00		
Bicarbonic acid (HCO_3)	100	63.57	59.91	49.77
Nitric acid (NO_3)	100	2.20	2.07	
Nitrous acid (NO_2)	50	.00		
Chlorin (Cl)	500	2.80	2.64	2.47
Bromin (Br)	1,000	.00		
Iodin (I)	1,000	.00		
Iron (Fe) Aluminum (Al)	2,000	.14	.13	
Manganese (Mn)	2,000	.00		
Calcium (Ca)	1,000	13.29	12.53	10.71
Magnesium (Mg)	1,000	4.34	4.09	3.69
Potassium (K)	2,000	.85	.80	.40
Sodium (Na)	2,000	4.60	4.34	2.26
Lithium (Li)	2,000	.00		
Ammonium (NH_4)	500	Trace.		
Oxygen (calculated) (O)		.06	.05	
Total		106.11	100.00	83.24
HYPOTHETICAL COMBINATIONS.				
Ammonium chlorid (NH_4Cl)		Trace.		
Lithium chlorid (LiCl)				
Potassium chlorid (KCl)		1.62	1.53	.76
Potassium bromid (KBr)				
Potassium sulphate (K_2SO_4)				
Sodium nitrate ($NaNO_3$)		3.20	3.02	
Sodium nitrite ($NaNO_2$)				
Sodium chlorid (NaCl)		3.35	3.16	3.48
Sodium sulphate (Na_2SO_4)		5.41	5.10	2.74
Sodium bicarbonate ($NaHCO_3$)		1.93	1.82	
Sodium metaborate ($NaBO_2$)				
Magnesium sulphate ($MgSO_4$)				1.29
Magnesium bicarbonate ($Mg(HCO_3)_2$)		26.07	24.56	20.61
Calcium chlorid ($CaCl_2$)				
Calcium sulphate ($CaSO_4$)				
Calcium bicarbonate ($Ca(HCO_3)_2$)		53.73	50.63	43.30
Calcium phosphate ($Ca_3(PO_4)_2$)				
Ferric oxid (Fe_2O_3) Alumina (Al_2O_3)		.20	.19	
Ferrous bicarbonate ($Fe(HCO_3)_2$)				
Calcium silicate ($CaSiO_3$)				
Silica (SiO_2)		10.60	9.99	11.06
Total		106.11	100.00	83.24

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[1] Made by Franklin C. Robinson (1896), and for purposes of comparison recalculated from original data according to the scheme adopted by the Bureau of Chemistry.

MAINE.

ROCKY HILL SPRING.

Misc. Div. No. 2147.

Gases.[1]

	cc
Carbon dioxid (free)	7. 20
Carbon dioxid (set free from bicarbonate upon evaporating to dryness)	11. 60
Hydrogen sulphid	. 00

Sanitary analysis.

	Parts per million.
Ammonia, free	Trace.
Ammonia albuminoid	Trace.
Nitrogen as nitrites	0. 00
Nitrogen as nitrates	. 50
Oxygen required	3. 50
Bacteriological data:	
Organisms per cc on plain agar after 48 hours at 37° C.	0
Organisms per cc on neutral red agar after 48 hours at 37° C.	0
Gas-forming organisms in 5 cc	......
Gas-forming organisms in 1 cc	0
Gas-forming organisms in 0.1 cc	0
Gas forming organisms in 0.01 cc	......

Rocky Hill Spring is situated in Fairfield, Somerset County, Me., and is owned and operated by W. N. Osborne. The spring was visited November 16, 1907, samples directly from source being obtained for examination. The flow was approximately 3 gallons per minute, with a temperature of 48° F. Chemical analysis shows this to be a moderately mineralized, calcic, magnesic, bicarbonate water of the alkaline type. The hypothetical combination indicates that approximately 50 per cent of the salts in solution in this water is bicarbonate of lime, with smaller amounts of the bicarbonates of magnesia and soda and about 5 per cent of sodium sulphate. The sanitary analysis shows only traces of organic matter, with a small amount of nitrogen in the form of nitrates, which, with an absence of bacteria, determines the water to be of high organic purity, while inspection of the premises failed to reveal any probable sources of pollution. The advertised analysis made in 1896 agrees fairly well with the analysis made by this bureau, the mineralization having slightly increased, however, since the former analysis was made.

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[1] At 0° C. and 760 mm pressure in 1,000 cc of water.

NEW HAMPSHIRE.

AMHERST MINERAL SPRING.

(Alkaline.)

Misc. Div. No. 2175.

Chemical analysis.

Constituents.	Examination by Bureau of Chemistry.			Advertised analysis.[1]
	Amount of water used for each determination.	Analysis.	Total inorganic material in solution.	
IONS.	*Grams.*	*Parts per million.*	*Per cent.*	*Parts per million.*
Phosphoric acid (PO_4)	500	0.00		
Metaboric acid (BO_2)	1,000	.00		
Arsenic acid (AsO_4)	1,000	.00		
Silica (SiO_2)	4,000	22.33	25.30	1.28
Sulphuric acid (SO_4)	2,000	4.40	4.98	19.15
Carbonic acid (CO_3)	100	.00		
Bicarbonic acid (HCO_3)	100	36.68	41.55	152.88
Nitric acid (NO_3)	100	Trace.		
Nitrous acid (NO_2)	50	Faint tr.		
Chlorin (Cl)	100	6.45	7.31	7.53
Bromin (Br)	1,000	.00		
Iodin (I)	1,000	.00		
Iron (Fe)	1,000	3.43	3.89	8.94
Aluminum (Al)				
Manganese (Mn)	1,000	.00		
Calcium (Ca)	1,000	7.72	8.74	39.18
Magnesium (Mg)	1,000	1.73	1.96	6.05
Potassium (K)	2,000	.90	1.02	2.24
Sodium (Na)	2,000	4.61	5.22	6.61
Lithium (Li)	2,000	.00		
Ammonium (NH_4)	500	.03	.03	
Oxygen (calculated) (O)				
Total		88.28	100.00	243.86
HYPOTHETICAL COMBINATIONS.				
Ammonium chlorid (NH_4Cl)		.08	.09	
Lithium chlorid (LiCl)				
Potassium chlorid (KCl)		1.72	1.95	4.27
Potassium bromid (KBr)				
Potassium sulphate (K_2SO_4)				
Sodium nitrate ($NaNO_3$)		Trace.		
Sodium nitrite ($NaNO_2$)		Faint tr.		
Sodium chlorid (NaCl)		9.20	10.42	9.07
Sodium sulphate (Na_2SO_4)		3.05	3.46	9.39
Sodium bicarbonate ($NaHCO_3$)				
Sodium metaborate ($NaBO_2$)				
Magnesium sulphate ($MgSO_4$)		2.93	3.32	16.04
Magnesium bicarbonate ($Mg(HCO_3)_2$)		6.85	7.76	16.91
Calcium chlorid ($CaCl_2$)				
Calcium sulphate ($CaSO_4$)				
Calcium bicarbonate ($Ca(HCO_3)_2$)		31.22	35.36	158.43
Calcium phosphate ($Ca_3(PO_4)_2$)				
Ferric oxid (Fe_2O_3)				
Alumina (Al_2O_3)				
Ferrous bicarbonate ($Fe(HCO_3)_2$)		10.90	12.34	28.47
Calcium silicate ($CaSiO_3$)				
Silica (SiO_2)		22.33	25.30	1.28
Total		88.28	100.00	243.86

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[1] Advertised analysis (no date) by Prof. J. F. Babcock. For purposes of comparison recalculated from the original data according to the scheme adopted by the Bureau of Chemistry.

NEW HAMPSHIRE.

AMHERST MINERAL SPRING.

Misc. Div. No. 2175.

Gases.[1]

	cc
Carbon dioxid (free)	7.8
Carbon dioxid (set free from bicarbonate upon evaporating to dryness)	6.7
Hydrogen sulphid	.0

Sanitary analysis.

	Parts per million.
Ammonia, free	0.026
Ammonia albuminoid	.020
Nitrogen as nitrites	Ft. tr.
Nitrogen as nitrates	Trace.
Oxygen required	1.000
Bacteriological data:[2]	
Organisms per cc on plain agar after 48 hours at 37° C	......
Organisms per cc on neutral red agar after 48 hours at 37° C	......
Gas-forming organisms in 5 cc	......
Gas-forming organisms in 1 cc	......
Gas-forming organisms in 0.1 cc	......
Gas-forming organisms in 0.01 cc	......
B. coli communis	......
Streptococci	......

Amherst Mineral Spring is situated at Amherst, Hillsboro County, N. H., and is owned and operated by Messrs. Geo. C. & E. A. Boutell, of Pittsfield, Mass. The spring was visited in November, 1907, samples directly from source being obtained for the examination. Chemical analysis shows this to be a calcic, sodic, ferruginous, bicarbonated water of the alkaline type. Approximately 55 per cent of the salts in solution are in the form of bicarbonates of lime, magnesia, and iron, with a small amount of the sulphate of magnesia and the sulphate and chlorid of soda. The sanitary analysis shows small quantities of free and albuminoid ammonia, with traces of nitrites and nitrates. Inspection of the premises failed to reveal any probable source of pollution. The advertised analysis differs very materially from the analysis made by this bureau.

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[1] At 0° C. and 760 mm pressure in 1,000 cc of water.

[2] No bacteriological sample taken.

NEW HAMPSHIRE.

GRANITE STATE SPRING.

Alkaline.

Misc. Div. No. 2174.

Chemical analysis.

Constituents.	Examination by Bureau of Chemistry.			Advertised analysis.
	Amount of water used for each determination.	Analysis.	Total inorganic material in solution.	
IONS.	*Grams.*	*Parts per million.*	*Per cent*	*Parts per million.*
Phosphoric acid (PO_4)	500	0.00		
Metaboric acid (BO_2)	1,000	.00		
Arsenic acid (AsO_4)	1,000	.00		
Silica (SiO_2)	7,000	15.18	16.56	
Sulphuric acid (SO_4)	2,800	3.81	4.16	
Carbonic acid (CO_3)	100	.00		
Bicarbonic acid (HCO_3)	100	40.04	43.69	
Nitric acid (NO_3)	100	7.05	7.69	
Nitrous acid (NO_2)	50	.00		
Chlorin (Cl)	500	4.924	5.37	
Bromin (Br)	1,000	.00		
Iodin (I)	1,000	.00		
Iron (Fe) Aluminum (Al)	2,000	.39	.43	
Manganese (Mn)	2,000	.00		
Calcium (Ca)	1,400	9.43	10.29	
Magnesium (Mg)	1,400	1.96	2.14	
Potassium (K)	2,800	1.45	1.58	
Sodium (Na)	2,800	7.26	7.92	
Lithium (Li)	2,800	.00		
Ammonium (NH_4)	500	.002		
Oxygen (calculated) (O)		.16	.17	
Total		91.656	100.00	
HYPOTHETICAL COMBINATIONS.				
Ammonium chlorid (NH_4Cl)		.006	.01	
Lithium chlorid (LiCl)				
Potassium chlorid (KCl)		2.76	3.00	
Potassium bromid (KBr)				
Potassium sulphate (K_2SO_4)				
Sodium nitrate ($NaNO_3$)		9.55	10.41	
Sodium nitrite ($NaNO_2$)				
Sodium chlorid (NaCl)		5.96	6.54	
Sodium sulphate (Na_2SO_4)		5.64	6.16	
Sodium bicarbonate ($NaHCO_3$)		2.11	2.30	
Sodium metaborate ($NaBO_2$)				
Magnesium chlorid ($MgCl_2$)				
Magnesium bicarbonate ($Mg(HCO_3)_2$)		11.78	12.84	
Calcium chlorid ($CaCl_2$)				
Calcium sulphate ($CaSO_4$)				
Calcium bicarbonate ($Ca(HCO_3)_2$)		38.12	41.58	
Calcium phosphate ($Ca_3(PO_4)_2$)				
Ferric oxid (Fe_2O_3) Alumina (Al_2O_3)		.55	.60	
Ferrous bicarbonate ($Fe(HCO_3)_2$)				
Calcium silicate ($CaSiO_3$)				
Silica (SiO_2)		15.18	16.56	
Total		91.656	100.00	

NEW HAMPSHIRE.

GRANITE STATE SPRING.

Misc. Div. No. 2174.

Gases.[1]

	cc
Carbon dioxid (free)	0.4
Carbon dioxid (set free from bicarbonate upon evaporating to dryness)	7.4
Hydrogen sulphid	.0

Sanitary analysis.

	Parts per million.
Ammonia, free	0.002
Ammonia albuminoid	.036
Nitrogen as nitrites	.000
Nitrogen as nitrates	1.600
Oxygen required	.....
Bacteriological data:	
Organisms per cc on plain agar after 48 hours at 37° C	1
Organisms per cc on neutral red agar after 48 hours at 37° C	0
Gas-forming organisms in 5 cc	.....
Gas-forming organisms in 1 cc	0
Gas-forming organisms in 0.1 cc	0
Gas-forming organisms in 0.01 cc	.....

Granite State Spring is situated at Plaistow, Rockingham County, N. H., and is owned and operated by the Granite State Spring Water Co. It was inspected on November 26, 1907, samples directly from source being obtained for examination. The flow was approximately 500 gallons per hour, with a temperature of 40° F. The chemical analysis shows this to be a moderately mineralized, calcic, sodic, bicarbonated water of the alkaline type. Hypothetical combination indicates approximately 54 per cent of the salts in solution to be in the form of bicarbonates of calcium and magnesium, with 10 per cent of sodium nitrate and smaller amounts of the chlorid, sulphate, and bicarbonate of sodium. The sanitary analysis shows small amounts of ammonia and larger quantities of nitrates, but a very low bacterial count, which indicates organic purity. Inspection of the premises failed to reveal any probable sources of pollution. No advertised analysis of this water could be obtained for purposes of comparison.

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[1] At 0° C. and 760 mm pressure in 1,000 cc of water.

NEW HAMPSHIRE.

HALE SPRING.

(Alkaline.)

Misc. Div. No. 4715.

Chemical analysis.

Constituents	Examination by Bureau of Chemistry.			Advertised analysis.
	Amount of water used for each determination.	Analysis.	Total inorganic material in solution.	
IONS.	*Grams.*	*Parts per million.*	*Per cent.*	*Parts per million.*
Phosphoric acid (PO_4)	500	0.00		
Metaboric acid (BO_2)	500	Traces.		
Arsenic acid (AsO_4)	500	.00		
Silica (SiO_2)	4,000	7.40	12.46	
Sulphuric acid (SO_4)	4,000	4.90	8.25	
Carbonic acid (CO_3)	100	.00		
Bicarbonic acid (HCO_3)	100	24.20	40.77	
Nitric acid (NO_3)	100	2.94	4.95	
Nitrous acid (NO_2)	100	Trace.		
Chlorin (Cl)	500	5.10	8.59	
Bromin (Br)	1,000	.00		
Iodin (I)	1,000	.00		
Iron (Fe)	4,000	.30	.52	
Aluminum (Al)				
Manganese (Mn)	4,000	.00		
Calcium (Ca)	4,000	7.80	13.14	
Magnesium (Mg)	4,000	1.20	2.02	
Potassium (K)	4,000	1.00	1.68	
Sodium (Na)	4,000	4.30	7.24	
Lithium (Li)	4,000	.00		
Ammonium (NH_4)	500	Trace.		
Oxygen (calculated) (O)		.23	.38	
Total		59.37	100.00	
HYPOTHETICAL COMBINATIONS.				
Ammonium chlorid (NH_4Cl)		Trace.		
Lithium chlorid ($LiCl$)		.00		
Potassium chlorid (KCl)		1.90	3.20	
Potassium bromid (KBr)				
Potassium sulphate (K_2SO_4)				
Sodium nitrate ($NaNO_3$)		4.04	6.81	
Sodium nitrite ($NaNO_2$)		Trace.		
Sodium chlorid ($NaCl$)		6.90	11.62	
Sodium sulphate (Na_2SO_4)		1.50	2.53	
Sodium bicarbonate ($NaHCO_3$)				
Sodium metaborate ($NaBO_2$)		Trace.		
Magnesium sulphate ($MgSO_4$)		4.90	8.25	
Magnesium bicarbonate ($Mg(HCO_3)_2$)		1.20	2.02	
Calcium chlorid ($CaCl_2$)				
Calcium sulphate ($CaSO_4$)				
Calcium bicarbonate ($Ca(HCO_3)_2$)		30.80	51.88	
Calcium phosphate ($Ca_3(PO_4)_2$)				
Ferric oxid (Fe_2O_3)		.43	.72	
Alumina (Al_2O_3)				
Ferrous bicarbonate ($Fe(HCO_3)_2$)				
Calcium silicate ($CaSiO_3$)		.60	1.01	
Silica (SiO_2)		7.10	11.96	
Total		59.37	100.00	

NEW HAMPSHIRE.

HALE SPRING.

Misc. Div. No. 4715.

Gases.[1]

	cc
Carbon dioxid (free)	6. 8
Carbon dioxid (set free from bicarbonate upon evaporating to dryness)	4. 4
Hydrogen sulphid	0. 0

Sanitary analysis.

		Parts per million.
Ammonia, free		Trace.
Ammonia albuminoid		0. 03
Nitrogen as nitrites		Trace.
Nitrogen as nitrates		. 666
Oxygen required		
Bacteriological data:		
Organisms per cc on plain agar after 48 hours at 37° C	64, 000	
Organisms per cc on neutral red agar after 48 hours at 37° C	17, 500	
Gas-forming organisms in 5 cc	....	
Gas-forming organisms in 1 cc	0	
Gas-forming organisms in 0.1 cc	0	
Gas-forming organisms in 0.01 cc	....	

Hale Spring is situated at Plaistow, N. H., and is owned by the Hale Spring Water Co. It was inspected November 26, 1907, samples directly from source being obtained for examination. The flow was about 120 gallons per minute, with a temperature of 48° F. Chemical analysis shows this to be a sodic, calcic, bicarbonated water of the alkaline type. The hypothetical combination indicates that approximately 54 per cent of the salts in solution are in the form of bicarbonates of calcium and magnesium, 18 per cent of chlorid and nitrate of sodium, and 8 per cent of sulphate of magnesium. The sanitary alalysis shows only a small amount of ammonia and nitrates, but the bacterial count is exceedingly high. Inspection of the premises failed to reveal any probable source of pollution. No advertised analysis of this water could be obtained for purposes of comparison.

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[1] At 0° C. and 760 mm pressure in 1,000 cc of water.

NEW HAMPSHIRE.

LAFAYETTE MINERAL SPRING.

(Alkaline.)

Misc. Div. No. 4716.

Chemical analysis.

Constituents.	Examination by Bureau of Chemistry.			Advertised analysis.[1]
	Amount of water used for each determination.	Analysis.	Total inorganic material in solution.	
IONS.	*Grams.*	*Parts per million.*	*Per cent.*	*Parts per million.*
Phosphoric acid (PO_4)	500	0.00		
Metaboric acid (BO_2)	500	.00		
Arsenic acid (AsO_4)	500	.00		
Silica (SiO_2)	4,000	20.40	14.38	18.35
Sulphuric acid (SO_4)	4,000	14.30	10.08	16.11
Carbonic acid (CO_3)	100	.00		
Bicarbonic acid (HCO_3)	100	69.60	49.06	84.24
Nitric acid (NO_3)	100	.33	.23	
Nitrous acid (NO_2)	100	St. tr.		
Chlorin (Cl)	500	2.80	1.98	2.75
Bromin (Br)	1,000	.00		
Iodin (I)	1,000	.00		
Iron (Fe)	4,000	.30	.21	.89
Aluminum (Al)				
Manganese (Mn)	4,000	.00		
Calcium (Ca)	4,000	19.30	13.60	15.80
Magnesium (Mg)	4,000	2.00	1.41	7.27
Potassium (K)	4,000	2.90	2.04	1.92
Sodium (Na)	4,000	9.20	6.48	8.29
Lithium (Li)	4,000	.00		
Ammonium (NH_4)	500	.02	.02	
Oxygen (calculated) (O)		.73	.51	.38
Total		141.88	100.00	156.00
HYPOTHETICAL COMBINATIONS.				
Ammonium chlorid (NH_4Cl)		.06	.04	
Lithium chlorid (LiCl)		.00		
Potassium chlorid (KCl)		5.56	3.92	3.66
Potassium bromid (KBr)				
Potassium sulphate (K_2SO_4)				
Sodium nitrate ($NaNO_3$)		.43	.30	
Sodium nitrite ($NaNO_2$)		St. tr.		
Sodium chlorid (NaCl)		.20	.14	1.67
Sodium sulphate (Na_2SO_4)		21.20	14.94	23.53
Sodium bicarbonate ($NaHCO_3$)		7.70	5.43	
Sodium metaborate ($NaBO_2$)				
Magnesium sulphate ($MgSO_4$)				.26
Magnesium bicarbonate ($Mg(HCO_3)_2$)		12.00	8.46	43.38
Calcium chlorid ($CaCl_2$)				
Calcium sulphate ($CaSO_4$)				
Calcium bicarbonate ($Ca(HCO_3)_2$)		71.70	50.53	63.88
Calcium phosphate ($Ca_3(PO_4)_2$)				
Ferric oxid (Fe_2O_3)		.43	.30	1.27
Alumina (Al_2O_3)				
Ferrous bicarbonate ($Fe(HCO_3)_2$)				
Calcium silicate ($CaSiO_3$)		4.60	3.25	
Silica (SiO_2)		18.00	12.69	18.35
Total		141.88	100.00	156.00

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[1] Advertised analysis (no date) by E. R. Angell. For purposes of comparison recalculated from original data according to the scheme adopted by the Bureau of Chemistry.

NEW HAMPSHIRE.

LAFAYETTE MINERAL SPRING.

Misc. Div. No. 4716.

Gases.[1]

	cc
Carbon dioxid (free)	2.9
Carbon dioxid (set free from bicarbonate upon evaporating to dryness)	12.8
Hydrogen sulphid	.0

Sanitary analysis.

	Parts per million.
Ammonia, free	0.020
Ammonia albuminoid	.030
Nitrogen as nitrites	Ft. tr.
Nitrogen as nitrates	.075
Oxygen required	.030
Bacteriological data:	......
Organisms per cc on plain agar after 48 hours at 37° C	14
Organisms per cc on neutral red agar after 48 hours at 37° C	3
Gas-forming organisms in 5 cc	......
Gas-forming organisms in 1 cc	+
Gas-forming organisms in 0.1 cc	0
Gas-forming organisms in 0.01 cc	......

Lafayette Mineral Spring is situated at Derry, Rockingham County, N. H., and is owned and operated by the Lafayette Mineral Spring Co. It was inspected November 28, 1907, samples directly from source being obtained for examination. The flow was approximately 3 gallons per minute at a temperature of 47° F. The chemical analysis shows this to be a moderately mineralized, calcic, sodic, bicarbonated water of the alkaline type. The hypothetical combination indicates that approximately 59 per cent of the salts in solution are present as bicarbonates of lime and magnesia and 15 per cent as sulphate of soda, with a smaller amount of bicarbonate of soda. The sanitary analysis shows small quantities of free and albuminoid ammonia and a faint trace of nitrite. The bacterial count is low, but gas-forming organisms were determined in 1-cc quantities. Inspection of the premises revealed them to be in a far from sanitary condition, as the spring was not properly protected, evidently being capable of contamination by surface drainage. The advertised analysis, with the exception of magnesia, agrees fairly with that made by this bureau.

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[1] At 0° C. and 760 mm pressure in 1,000 cc of water.

NEW HAMPSHIRE.

LONDONDERRY SPRING.

(Alkaline.)

Misc. Div. No. 2173.

Chemical analysis.

Constituents.	Examination by Bureau of Chemistry.			Advertised analysis.[1]
	Amount of water used for each determination.	Analysis.	Total inorganic material in solution.	
IONS.	*Grams.*	*Parts per million.*	*Per cent.*	*Parts per million.*
Phosphoric acid (PO_4)	500	0.000		
Metaboric acid (BO_2)	1,000	.000		
Arsenic acid (AsO_4)	1,000	.000		
Silica (SiO_2)	7,000	14.040	20.48	6.50
Sulphuric acid (SO_4)	2,800	8.430	12.30	145.27
Carbonic acid (CO_3)	100	.000		237.90
Bicarbonic acid (HCO_3)	100	28.750	41.95	160.10
Nitric acid (NO_3)	100	Trace.		
Nitrous acid (NO_2)	50	V. ft. tr.		
Chlorin (Cl)	500	2.295	3.35	213.40
Bromin (Br)	1,000	.000		
Iodin (I)	1,000	.000		
Iron (Fe) Aluminum (Al)	1,000	.350	.51	3.15
Manganese (Mn)	2,000	.000		
Calcium (Ca)	1,400	8.860	12.93	3.33
Magnesium (Mg)	1,400	1.090	1.59	12.20
Potassium (K)	2,800	1.000	1.46	7.00
Sodium (Na)	2,800	3.560	5.19	385.80
Lithium (Li)	2,800	[2] Ft. tr.		10.30
Ammonium (NH_4)	500	.013	.02	
Oxygen (calculated) (O)		.150	.22	1.35
Total		68.538	100.00	1,186.30
HYPOTHETICAL COMBINATIONS.				
Ammonium chlorid (NH_4Cl)		.038	.06	
Lithium chlorid (LiCl)		Ft. tr.		62.24
Potassium chlorid (KCl)		1.900	2.77	13.34
Potassium bromid (KBr)				
Potassium sulphate (K_2SO_4)				
Sodium nitrate ($NaNO_3$)		Trace.		
Sodium carbonate (Na_2CO_3)				420.78
Sodium chlorid (NaCl)		2.270	3.31	255.98
Sodium sulphate (Na_2SO_4)		8.200	11.96	214.99
Sodium bicarbonate ($NaHCO_3$)				118.40
Sodium metaborate ($NaBO_2$)				
Magnesium sulphate ($MgSO_4$)		3.620	5.28	
Magnesium bicarbonate ($Mg(HCO_3)_2$)		2.160	3.15	73.41
Calcium chlorid ($CaCl_2$)				
Calcium sulphate ($CaSO_4$)				
Calcium bicarbonate ($Ca(HCO_3)_2$)		35.810	52.26	13.46
Calcium phosphate ($Ca_3(PO_4)_2$)				
Ferric oxid (Fe_2O_3) Alumina (Al_2O_3)		.500	.72	2.64
Ferrous bicarbonate ($Fe(HCO_3)_2$)				4.56
Calcium silicate ($CaSiO_3$)				
Silica (SiO_2)		14.040	20.49	6.50
Total		68.538	100.00	1,186.30

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[1] Made (no date) by Prof. R. Ogden Doremus. For purposes of comparison, recalculated from original data according to the scheme adopted by the Bureau of Chemistry.

[2] Spectroscopic trace.

NEW HAMPSHIRE.

LONDONDERRY SPRING.

Misc. Div. No. 2173.

Gases.[1]

	cc
Carbon dioxid (free)	5. 7
Carbon dioxid (set free from bicarbonate upon evaporating to dryness)	5. 3
Hydrogen sulphid	.0

Sanitary analysis.

	Parts per million.
Ammonia, free	0. 012
Ammonia albuminoid	. 052
Nitrogen as nitrites	V. ft. tr.
Nitrogen as nitrates	Trace.
Oxygen required	1. 50
Bacteriological data:	
Organisms per cc on plain agar after 48 hours at 37° C	3
Organisms per cc on neutral red agar after 48 hours at 37° C	1
Gas-forming organisms in 5 cc	......
Gas-forming organisms in 1 cc	0
Gas-forming organisms in 0.1 cc	0
Gas-forming organisms in 0.01 cc	......

The Londonderry Spring is situated at Londonderry, Rockingham County, N. H., and is owned and operated by the Londonderry Spring Water Co., of Nashua, N. H., large quantities of the water being bottled for sale. The spring was inspected on November 29, 1907, samples directly from source being obtained for examination. The flow was approximately 10 gallons per minute, with a temperature of 46° F. Chemical analysis shows this to be a lightly mineralized, calcic, sodic, bicarbonated water of the alkaline type. The hypothetical combination indicates that approximately 55 per cent of the total salts in solution are in the form of the bicarbonates of calcium and magnesium, with 12 per cent of sulphate of sodium, and a smaller amount of sulphate of magnesium. The sanitary analysis shows a small amount of free ammonia, considerable albuminoid ammonia, and very faint traces of nitrites. The bacterial count was very low, and an inspection of the premises failed to reveal any probable sources of pollution. The analysis made by this bureau differs very materially from the advertised analysis, which does not represent the constituents found in the natural water.

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[1] At 0° C. and 760 mm pressure in 1,000 cc of water.

NEW HAMPSHIRE.

PACK MONADNOCK LITHIA SPRING.

(Alkaline.)

Misc. Div. No. 8861.

Chemical analysis.

Constituents.	Examination by Bureau of Chemistry.			Advertised analysis.[1]
	Amount of water used for each determination.	Analysis.	Total inorganic material in solution.	
IONS.	*Grams.*	*Parts per million.*	*Per cent.*	*Parts per million.*
Phosphoric acid (PO_4)				
Metaboric acid (BO_2)				
Arsenic acid (AsO_4)				
Silica (SiO_2)	3,000	13.90	34.0	14.01
Sulphuric acid (SO_4)	2,000	2.50	6.1	4.03
Carbonic acid (CO_3)	100	None.		9.59
Bicarbonic acid (HCO_3)	100	14.28	34.9	255.00
Nitric acid (NO_3)	100	.03	.1	
Nitrous acid (NO_2)				
Chlorin (Cl)	1,000	2.37	5.8	4.17
Bromin (Br)				
Iodin (I)				
Iron (Fe) Aluminum (Al)	3,000	.29	.7	1.37
Manganese (Mn)	250	.00		
Calcium (Ca)	3,000	2.60	6.4	4.41
Magnesium (Mg)	3,000	.70	1.7	1.21
Potassium (K)	2,000	.70	1.7	4.63
Sodium (Na)	2,000	3.40	8.3	22.54
Lithium (Li)	2,000	[2] Trace.		22.76
Ammonium (NH_4)		Trace.		
Oxygen (calculated) (O)		.11	.3	
Total		40.88	100.00	343.72
HYPOTHETICAL COMBINATIONS.				
Ammonium chlorid (NH_4Cl)		Trace.		
Lithium chlorid (LiCl)		Trace.		5.00
Potassium chlorid (KCl)		1.33	3.3	
Lithium sulphate (Li_2SO_4)				4.62
Lithium carbonate (Li_2CO_3)				11.84
Sodium nitrate ($NaNO_3$)		.04	.1	
Lithium bicarbonate ($LiHCO_3$)				184.76
Sodium chlorid (NaCl)		2.87	7.0	
Sodium sulphate (Na_2SO_4)		3.70	9.0	
Sodium bicarbonate ($NaHCO_3$)		3.87	9.5	82.20
Potassium bicarbonate ($KHCO_3$)				11.84
Magnesium chlorid ($MgCl_2$)				
Magnesium bicarbonate ($Mg(HCO_3)_2$)		4.21	10.3	7.27
Calcium chlorid ($CaCl_2$)				
Calcium sulphate ($CaSO_4$)				
Calcium bicarbonate ($Ca(HCO_3)_2$)		10.51	25.8	17.83
Calcium phosphate ($Ca_3(PO_4)_2$)				
Ferric oxid (Fe_2O_3) Alumina (Al_2O_3)		.38	.8	
Ferrous bicarbonate ($Fe(HCO_3)_2$)		.07	.2	4.35
Calcium silicate ($CaSiO_3$)				
Silica (SiO_2)		13.90	34.0	14.01
Total		40.88	100.0	343.72

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[1] For purposes of comparison, recalculated from original data according to the scheme adopted by the Bureau of Chemistry.

[2] Lithium, spectroscopic trace.

NEW HAMPSHIRE.

PACK MONADNOCK LITHIA SPRING.

Misc. Div. No. 8861.

Gases.[1]

	cc
Carbon dioxid (free)	3.7
Carbon dioxid (set free from bicarbonate upon evaporating to dryness)	2.6
Hydrogen sulphid	.0

Sanitary analysis.

	Parts per million.
Ammonia, free	Trace.
Ammonia albuminoid	0.014
Nitrogen as nitrites	.000
Nitrogen as nitrates	.007
Oxygen required	.260
Bacteriological data:	
Organisms per cc on plain agar after 48 hours at 37° C.	1
Organisms per cc on neutral red agar after 48 hours at 37° C.	2
Gas-forming organisms in 5 cc	.....
Gas-forming organisms in 1 cc	.....
Gas-forming organisms in 0.1 cc	.....
Gas-forming organisms in 0.01 cc	.....

Pack Monadnock Lithia Spring is situated at Temple, N. H., and is owned and operated by S. A. Scammon. It was inspected November 27, 1907, and again February 24, 1910, samples from source being obtained for the purpose of examination. The flow of this spring is approximately 2 gallons per minute, with a temperature of 43° F. The chemical analysis shows it to be a lightly mineralized, sodic, calcic, bicarbonated water of the alkaline type. The hypothetical combination indicates that approximately 36 per cent of the salts in solution are the bicarbonates of calcium and magnesium, 10 per cent sodium bicarbonate, 9 per cent sodium sulphate, and 7 per cent sodium chlorid. The sanitary analysis shows only a trace of free ammonia, small quantities of albuminoid ammonia and nitrites, and a very low bacterial count. Inspection of the premises failed to reveal any probable sources of pollution. The analysis made in this bureau differs very markedly from the advertised analysis, the latter failing to represent the character of the water from source. The difference between the two analyses is wholly inexplainable.

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[1] At 0° C. and 760 mm pressure in 1,000 cc of water.

VERMONT.

CLARENDON MINERAL SPRING.

(Alkaline.)

Misc. Div. No. 2177.

Chemical analysis.

Constituents.	Examination by Bureau of Chemistry.			Advertised analysis.[1]
	Amount of water used for each determination.	Analysis.	Total inorganic material in solution.	
IONS.	*Grams.*	*Parts per million.*	*Per cent.*	*Parts per million.*
Phosphoric acid (PO_4)	500	0.00		
Metaboric acid (BO_2)	1,000	.00		
Arsenic acid (AsO_4)	1,000	.00		
Silica (SiO_2)	7,000	14.01	3.75	11.24
Sulphuric acid (SO_4)	2,800	6.35	1.70	6.02
Carbonic acid (CO_3)	100	.00		
Bicarbonic acid (HCO_3)	100	268.81	71.87	168.78
Nitric acid (NO_3)	100	2.20	.59	
Nitrous acid (NO_2)	50	.00		
Chlorin (Cl)	500	2.60	.69	2.32
Bromin (Br)	1,000	.00		
Iodin (I)	1,000	.00		
Iron (Fe)	2,000	.49	.13	.37
Aluminum (Al)				.42
Manganese (Mn)	2,000	.00		
Calcium (Ca)	1,400	51.75	13.83	47.42
Magnesium (Mg)	1,400	22.86	6.12	6.42
Potassium (K)	2,800	.97	.26	.89
Sodium (Na)	2,800	3.79	1.01	.99
Lithium (Li)	2,800	.00		
Ammonium (NH_4)	500	Trace.		
Oxygen (calculated) (O)		.21	.05	.54
Total		374.04	100.00	245.41
HYPOTHETICAL COMBINATIONS.				
Ammonium chlorid (NH_4Cl)		Trace.		
Lithium chlorid (LiCl)		.00		
Potassium chlorid (KCl)		1.85	.49	1.70
Potassium bromid (KBr)				
Potassium sulphate (K_2SO_4)				
Sodium nitrate ($NaNO_3$)		3.02	.81	
Sodium nitrite ($NaNO_2$)				
Sodium chlorid (NaCl)		2.83	.76	2.50
Sodium sulphate (Na_2SO_4)		5.74	1.53	
Sodium bicarbonate ($NaHCO_3$)				
Sodium metaborate ($NaBO_2$)				
Magnesium sulphate ($MgSO_4$)		3.10	.83	7.55
Magnesium bicarbonate ($Mg(HCO_3)_2$)		133.58	35.71	29.38
Calcium chlorid ($CaCl_2$)				
Calcium sulphate ($CaSO_4$)				
Calcium bicarbonate ($Ca(HCO_3)_2$)		209.21	55.95	191.71
Calcium phosphate ($Ca_3(PO_4)_2$)				
Ferric oxid (Fe_2O_3)		.70	.18	.53
Alumina (Al_2O_3)				.80
Ferrous bicarbonate ($Fe(HCO_3)_2$)				
Calcium silicate ($CaSiO_3$)				
Silica (SiO_2)		14.01	3.74	11.24
Total		374.04	100.00	245.41

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[1] Made in 1899 by Ricketts and Banks. Recalculated from original data, according to the scheme adopted by the Bureau of Chemistry, for purposes of comparison.

VERMONT.

CLARENDON MINERAL SPRING.

Misc. Div. No. 2177.

Gases.[1]

	cc
Carbon dioxid (free)	2. 20
Carbon dioxid (set free from bicarbonate upon evaporating to dryness)	49. 2
Hydrogen sulphid	. 0

Sanitary analysis.

	Parts per million.
Ammonia, free	Trace.
Ammonia albuminoid	0. 004
Nitrogen as nitrites	. 000
Nitrogen as nitrates	. 500
Oxygen required	. 000
Bacteriological data:	
Organisms per cc on plain agar after 48 hours at 37° C	23
Organisms per cc on neutral red agar after 48 hours at 37° C	34
Gas-forming organisms in 5 cc	......
Gas-forming organisms in 1 cc	......
Gas-forming organisms in 0.1 cc	......
Gas-forming organisms in 0.01 cc	......

Clarendon Mineral Spring is situated at Clarendon, Rockingham County, Vt., and is owned and operated by the Clarendon Mineral Spring Co. It was inspected November 22, 1907, samples directly from source being obtained for the examination. The flow was said to be approximately 20 gallons per minute, with a temperature of 49° F. The chemical analysis shows this to be a highly mineralized, calcic, magnesic, bicarbonated water of the alkaline type. The hypothetical combination indicates that approximately 90 per cent of the salts in solution are in the form of bicarbonates of calcium and magnesium. The sanitary analysis shows only a trace of free ammonia, small quantities of albuminoid ammonia and nitrates, with a low bacterial count, which indicates organic purity. Inspection of the premises failed to reveal any probable source of pollution. The advertised analysis made in 1899 differs largely from the analysis made in this bureau.

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[1] At 0° C. 760 mm pressure in 1,000 cc of water.

VERMONT.

EQUINOX SPRING.

(Alkaline.)

Misc. Div. No. 2178.

Chemical analysis.

Constituents.	Examination by Bureau of Chemistry.			Advertised analysis.[1]
	Amount of water used for each determination.	Analysis.	Total inorganic material in solution.	
IONS.	*Grams.*	*Parts per million.*	*Per cent.*	*Parts per million.*
Phosphoric acid (PO_4)	500	0.00		
Metaboric acid (BO_2)	1,000	.00		
Arsenic acid (AsO_4)	1,000	.00		
Silica (SiO_2)	7,000	35.07	45.09	3.09
Sulphuric acid (SO_4)	2,800	1.95	2.51	2.53
Carbonic acid (CO_3)	100	.00		
Bicarbonic acid (HCO_3)	100	27.22	35.00	33.48
Nitric acid (NO_3)	100	1.77	2.27	
Nitrous acid (NO_2)	50	.00		
Chlorin (Cl)	500	1.20	1.54	4.99
Bromin (Br)	1,000	.00		
Iodin (I)	1,000	.00		
Iron (Fe) Aluminum (Al)	2,000	.56	.72	.17
Manganese (Mn)	2,000	.00		
Calcium (Ca)	1,400	5.29	6.80	9.16
Magnesium (Mg)	1,400	1.77	2.27	1.58
Potassium (K)	2,800	.42	.54	.60
Sodium (Na)	2,800	2.53	3.26	3.24
Lithium (Li)	2,800	.00		
Ammonium (NH_4)	500	Trace.		
Oxygen (calculated) (O)				.07
Total		77.78	100.00	58.91
HYPOTHETICAL COMBINATIONS.				
Ammonium chlorid (NH_4Cl)		Trace.		
Lithium chlorid (LiCl)		.00		
Potassium chlorid (KCl)		.80	1.03	1.14
Potassium bromid (KBr)				
Potassium sulphate (K_2SO_4)				
Sodium nitrate ($NaNO_3$)		2.43	3.12	
Sodium nitrite ($NaNO_2$)				
Sodium chlorid (NaCl)		1.35	1.73	7.34
Sodium sulphate (Na_2SO_4)		2.89	3.71	1.08
Sodium bicarbonate ($NaHCO_3$)		1.46	1.88	
Sodium metaborate ($NaBO_2$)				
Magnesium sulphate ($MgSO_4$)				2.26
Magnesium bicarbonate ($Mg(HCO_3)_2$)		10.63	13.67	6.73
Calcium chlorid ($CaCl_2$)				
Calcium sulphate ($CaSO_4$)				
Calcium bicarbonate ($Ca(HCO_3)_2$)		21.37	27.48	37.03
Calcium phosphate ($Ca_3(PO_4)_2$)				
Ferric oxid (Fe_2O_3)				.24
Alumina (Al_2O_3)				
Ferrous bicarbonate ($Fe(HCO_3)_2$)		1.78	2.29	
Calcium silicate ($CaSiO_3$)				
Silica (SiO_2)		35.07	45.09	3.09
Total		77.78	100.00	58.91

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[1] Advertised analysis by C. F. Chandler and C. E. Pellew in 1892. Recalculated from original data according to the scheme adopted by the Bureau of Chemistry.

VERMONT.

EQUINOX SPRING.

Misc. Div. No. 2178.

Gases.[1]

	cc
Carbon dioxid (free)	0. 0
Carbon dioxid (set free from bicarbonate upon evaporating to dryness)	5. 0
Hydrogen sulphid	. 0

Sanitary analysis.	Parts per million.
Ammonia, free	Trace.
Ammonia albuminoid	0. 005
Nitrogen as nitrites	V. ft. tr.
Nitrogen as nitrates	. 400
Oxygen required	2. 500
Bacteriological data:	
Organisms per cc on plain agar after 48 hours at 37° C	0
Organisms per cc on neutral red agar after 48 hours at 37° C	0
Gas-forming organisms in 5 cc	....
Gas-forming organisms in 1 cc	0
Gas-forming organisms in 0.1 cc	0
Gas-forming organisms in 0.01 cc	....

Equinox Spring is situated near Manchester, Vt., and is owned and operated by the Equinox Spring Water Co., large quantities of the water being bottled for sale. The spring was inspected on November 22, 1907, samples directly from source being obtained for examination. The flow was approximately 60 gallons per minute, with a temperature of 44° F. Chemical analysis shows this to be a moderately mineralized, calcic, bicarbonate water of the alkaline type. The hypothetical combination shows that approximately 41 per cent of the salts in solution are the bicarbonates of calcium and magnesium, with smaller amounts of bicarbonate and sulphate of sodium. The sanitary analysis shows only traces of organic matter and a small amount of nitrate, with an absence of bacteria, which determines the water to be of high organic purity, while inspection failed to reveal any probable source of contamination. The advertised analysis made in 1892, with the exception of silica and chlorin, agrees fairly well with the analysis of this bureau.

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[1] At 0° C. and 760 mm pressure in 1,000 cc of water.

VERMONT.

MISSISQUOI SPRING.

(Alkaline.)

Misc. Div. No. 2176.

Chemical analysis.

Constituents.	Examination by Bureau of Chemistry.			Advertised analysis.[1]
	Amount of water used for each determination.	Analysis.	Total inorganic material in solution.	
Ions.	*Grams.*	*Parts per million.*	*Per cent.*	*Parts per million.*
Phosphoric acid (PO_4)	500	Trace.		0.05
Metaboric acid (BO_2)	1,000	0.00		
Arsenic acid (AsO_4)	1,000	.00		
Silica (SiO_2)	7,000	19.86	6.20	15.25
Sulphuric acid (SO_4)	2,800	19.18	5.98	19.61
Carbonic acid (CO_3)	100	.00		
Bicarbonic acid (HCO_3)	100	206.00	64.29	174.93
Nitric acid (NO_3)	100	Traces.		
Nitrous acid (NO_2)	100	.00		
Chlorin (Cl)	500	2.60	.81	2.03
Bromin (Br)	1,000	.00		
Iodin (I)	1,000	.00		
Iron (Fe)	1,000	1.59	.50	.95
Aluminum (Al)				.43
Manganese (Mn)	2,000	Trace.		.43
Calcium (Ca)	1,400	45.39	14.16	35.66
Magnesium (Mg)	1,400	14.29	4.46	13.27
Potassium (K)	2,800	1.18	.37	1.61
Sodium (Na)	2,800	9.43	2.95	7.54
Lithium (Li)	2,800	.00		
Ammonium (NH_4)	500	Trace.		.08
Oxygen (calculated) (O)		.91	.28	
Total		320.43	100.00	271.84
Hypothetical Combinations.				
Ammonium chlorid (NH_4Cl)		Trace.		.24
Lithium chlorid (LiCl)		.00		
Potassium chlorid (KCl)		2.25	.70	3.07
Potassium bromid (KBr)				
Potassium sulphate (K_2SO_4)				
Sodium nitrate ($NaNO_3$)		Trace.		
Sodium nitrite ($NaNO_2$)				
Sodium chlorid (NaCl)		2.52	.79	.68
Sodium sulphate (Na_2SO_4)		26.03	8.12	22.42
Sodium bicarbonate ($NaHCO_3$)				
Magnesium sulphate ($MgSO_4$)		1.99	.62	2.75
Magnesium chlorid ($MgCl_2$)				
Magnesium bicarbonate ($Mg(HCO_3)_2$)		83.46	26.04	76.27
Manganese bicarbonate ($(MnHCO_3)_2$)				1.40
Aluminum sulphate ($Al_2(SO_4)_3$)				2.70
Calcium bicarbonate ($Ca(HCO_3)_2$)		181.25	56.57	143.95
Calcium phosphate ($Ca_3(PO_4)_2$)		Trace.		.08
Ferric oxid (Fe_2O_3)		2.27	.71	
Alumina (Al_2O_3)				
Ferrous bicarbonate ($Fe(HCO_3)_2$)				3.03
Calcium silicate ($CaSiO_3$)		1.66	.52	
Silica (SiO_2)		19.00	5.93	15.25
Total		320.43	100.00	271.84

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[1] Analysis by Dr. R. A. Witthaus in 1888. For purposes of comparison, recalculated from original data according to the scheme adopted by the Bureau of Chemistry.

VERMONT.

MISSISQUOI SPRING.

Gases.[1]

	cc
Carbon dioxid (free)	....
Carbon dioxid (set free from bicarbonate upon evaporating to dryness)	37.8
Hydrogen sulphid	0.0

Sanitary analysis.

	Parts per million.
Ammonia, free	Trace.
Ammonia albuminoid	0.017
Nitrogen as nitrites	.000
Nitrogen as nitrates	Trace.
Oxygen required	......
Bacteriological data:	
Organisms per cc on plain agar after 48 hours at 37° C	50
Organisms per cc on neutral red agar after 48 hours at 37° C	0
Gas-forming organisms in 5 cc	0
Gas-forming organisms in 1 cc	0
Gas-forming organisms in 0.1 cc	0
Gas-forming organisms in 0.01 cc	0

The Missisquoi Spring is situated at Sheldon, Franklin County, Vt., and is owned and operated by the Missisquoi Mineral Spring Co. The spring was inspected November 21, 1907, samples from source being obtained for examination. The flow was approximately 1 quart per minute, with a temperature of 44°. The chemical analysis shows this to be a rather highly mineralized, calcic, magnesic, bicarbonated water of the alkaline type. The hypothetical combination shows that approximately 83 per cent of the salts in solution are in the form of the bicarbonates of calcium and magnesium, with small amount of sulphate of sodium. The sanitary analysis shows but little organic matter, with only a small number of bacteria, which indicates organic purity. Inspection of the premises failed to reveal any probable sources of pollution. The advertised analysis made in 1888 varies considerably from that made by this bureau, the mineralization of the spring having increased since the former analysis was made.

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[1] At 0° C. and 760 mm pressure in 1,000 cc of water.

MASSACHUSETTS.

BALLARDVALE SPRING.

(Alkaline-saline.)

Misc. Div. No. 2420.

Chemical analysis.

Constituents.	Examination by Bureau of Chemistry.			Advertised analysis.[1]
	Amount of water used for each determination.	Analysis.	Total inorganic material in solution.	
IONS.	*Grams.*	*Parts per million.*	*Per cent.*	*Parts per million.*
Phosphoric acid (PO_4)	....	....	....	0.00
Metaboric acid (BO_2)	....	....	....	....
Arsenic acid (AsO_4)	....	....	....	....
Silica (SiO_2)	3,000	7.30	34.2	7.74
Sulphuric acid (SO_4)	2,000	1.30	6.1	1.53
Carbonic acid (CO_3)	100	.00	....	....
Bicarbonic acid (HCO_3)	100	6.00	28.2	4.14
Nitric acid (NO_3)	100	.03	.1	Trace.
Nitrous acid (NO_2)	....	....	....	.00
Chlorin (Cl)	1,000	2.55	11.9	3.30
Bromin (Br)	....	....	....	....
Iodin (I)	....	....	....	....
Iron (Fe)	3,000	.07	.3	.02
Aluminum (Al)				.12
Manganese (Mn)	250	.00	....	....
Calcium (Ca)	3,000	1.13	5.3	.83
Magnesium (Mg)	3,000	.48	2.2	.36
Potassium (K)	2,000	.26	1.2	.28
Sodium (Na)	2,000	2.20	10.4	2.62
Lithium (Li)	2,000	.00	....	....
Ammonium (NH_4)	....	Trace.	....	.01
Oxygen (calculated) (O)	....	.03	.1	.11
Total	....	21.35	100.0	21.06
HYPOTHETICAL COMBINATIONS.				
Ammonium chlorid (NH_4Cl)	....	Trace.	....	.03
Lithium chlorid (LiCl)	....	.00	....	....
Potassium chlorid (KCl)	....	.49	2.3	.53
Potassium bromid (KBr)	....	....	....	....
Potassium sulphate (K_2SO_4)	....	....	....	....
Sodium nitrate ($NaNO_3$)	....	.05	.2	Trace.
Sodium nitrite ($NaNO_2$)	....	....	....	....
Sodium chlorid (NaCl)	....	3.82	18.0	5.00
Sodium sulphate (Na_2SO_4)	....	1.92	9.0	2.01
Sodium bicarbonate ($NaHCO_3$)	....	.25	1.1	....
Sodium metaborate ($NaBO_2$)	....	....	....	....
Magnesium sulphate ($MgSO_4$)	....	....	....	.21
Magnesium bicarbonate ($Mg(HCO_3)_2$)	....	2.88	13.5	1.93
Calcium chlorid ($CaCl_2$)	....	....	....	....
Calcium sulphate ($CaSO_4$)	....	....	....	....
Calcium bicarbonate ($Ca(HCO_3)_2$)	....	4.54	21.2	3.36
Calcium phosphate ($Ca_3(PO_4)_2$)	....	....	....	....
Ferric oxid (Fe_2O_3)	....	.10	.5	.03
Alumina (Al_2O_3)	....	....	....	.22
Ferrous bicarbonate ($Fe(HCO_3)_2$)	....	....	....	....
Calcium silicate ($CaSiO_3$)	....	....	....	....
Silica (SiO_2)	....	7.30	34.2	7.74
Total	....	21.35	100.0	21.06

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[1] Analysis by Prof. S. P. Sadtler, August, 1908. For purposes of comparison, recalculated from original data according to the scheme adopted by the Bureau of Chemistry.

MASSACHUSETTS.

BALLARDVALE SPRING.

Misc. Div. No. 2420.

Gases.[1]

	cc
Carbon dioxid (free)	1. 7
Carbon dioxid (set free from bicarbonate upon evaporating to dryness)	. 9
Hydrogen sulphid	. 0

Sanitary analysis.

	Parts per million.
Ammonia, free	Trace.
Ammonia albuminoid	0. 032
Nitrogen as nitrites	. 000
Nitrogen as nitrates	. 007
Oxygen required	......
Bacteriological data: [2]	
Organisms per cc on plain agar after 48 hours at 37° C	......
Organisms per cc on neutral red agar after 48 hours at 37° C	......
Gas-forming organisms in 5 cc	......
Gas-forming organisms in 1 cc	......
Gas-forming organisms in 0.1 cc	......
Gas-forming organisms in 0.01 cc	......

Ballardvale Spring is situated at Andover, Essex County, Mass., and is owned and operated by the Ballardvale Spring Co. The spring was visited February 11, 1910, samples directly from source being obtained for the examination. The spring has a large flow, but the volume could not be estimated. The temperature is 40° F. The chemical analysis shows this to be a very lightly mineralized, sodic, bicarbonated, muriated water of the alkaline-saline type. The hypothetical combination indicates that approximately 36 per cent of the salts in solution are in the form of the bicarbonates of calcium, magnesium, and sodium, 18 per cent of sodium chlorid, and 9 per cent of sodium sulphate. The sanitary analysis shows a small quantity of albuminoid ammonia and a very small amount of nitrates. Inspection of the premises failed to reveal any probable source of pollution. The advertised analysis made in 1898 agrees very closely with the analysis made in this bureau.

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[1] At 0° C. and 760 mm pressure in 1,000 cc of water.

[2] No bacteriological sample taken.

MASSACHUSETTS.

BELMONT HILL SPRING.

(Alkaline-saline.)

Misc. Div. No. 4847.

Chemical analysis.

Constituents.	Examination by Bureau of Chemistry.			Advertised analysis.[1]
	Amount of water used for each determination.	Analysis.	Total inorganic material in solution.	
Ions.	*Grams.*	*Parts per million.*	*Per cent.*	*Parts per million.*
Phosphoric acid (PO_4)	500	Trace.		
Metaboric acid (BO_2)	500	0.00		
Arsenic acid (AsO_4)	500	.00		
Silica (SiO_2)	4,000	11.70	4.69	7.00
Sulphuric acid (SO_4)	4,000	33.00	13.24	82.04
Carbonic acid (CO_3)	100	.00		
Bicarbonic acid (HCO_3)	100	42.40	17.01	74.46
Nitric acid (NO_3)	100	75.14	30.14	
Nitrous acid (NO_2)	100	.00		
Chlorin (Cl)	500	23.00	9.23	70.57
Bromin (Br)	1,000	.00		
Iodin (I)	1,000	.00		
Iron (Fe) Aluminum (Al)	4,000	.30	.12	1.40
Manganese (Mn)	4,000	.00		
Calcium (Ca)	4,000	28.80	11.55	36.44
Magnesium (Mg)	4,000	9.20	3.69	13.54
Potassium (K)	4,000	1.90	.76	26.41
Sodium (Na)	4,000	23.50	9.43	30.34
Lithium (Li)	4,000	[2] Ft. tr.		
Ammonium (NH_4)	500	.04	.02	.08
Oxygen (calculated) (O)		.33	.12	.60
Total		249.31	100.00	342.88
Hypothetical Combinations.				
Ammonium chlorid (NH_4Cl)		.12	.04	.24
Lithium chlorid (LiCl)		Ft. tr.		
Potassium chlorid (KCl)				50.32
Potassium bromid (KBr)				
Potassium nitrate (KNO_3)		4.90	1.96	
Sodium nitrate ($NaNO_3$)		86.74	34.80	
Sodium nitrite ($NaNO_2$)				
Sodium chlorid (NaCl)				76.84
Sodium sulphate (Na_2SO_4)				
Magnesium nitrate ($MgNO_3$)		10.60	4.25	
Magnesium sulphate ($MgSO_4$)				66.93
Magnesium chlorid ($MgCl_2$)		29.32	11.76	
Magnesium bicarbonate ($Mg(HCO_3)_2$)				
Calcium chlorid ($CaCl_2$)		1.70	.68	
Calcium sulphate ($CaSO_4$)		46.80	18.78	40.62
Calcium bicarbonate ($Ca(HCO_3)_2$)		56.30	22.59	98.93
Calcium phosphate ($Ca_3(PO_4)_2$)				
Ferric oxid (Fe_2O_3) Alumina (Al_2O_3)		.43	.17	2.00
Ferrous bicarbonate ($Fe(HCO_3)_2$)				
Calcium silicate ($CaSiO_3$)		1.50	.60	
Silica (SiO_2)		10.90	4.37	7.00
Total		249.31	100.00	342.88

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[1] Made (no date) by H. L. Bowker, State assayer of Massachusetts. Recalculated from original data according to the scheme adopted by the Bureau of Chemistry.

[2] Spectroscopic trace.

MASSACHUSETTS.

BELMONT HILL SPRING.

Misc. Div. No. 4847.

Gases. [1]

	cc
Carbon dioxid (free)	11.2
Carbon dioxid (set free from bicarbonate upon evaporating to dryness)	7.8
Hydrogen sulphid	.0

Sanitary analysis.

	Parts per million.	
Ammonia, free		0.040
Ammonia albuminoid		.034
Nitrogen as nitrites		.000
Nitrogen as nitrates		17.000
Oxygen required		.100
Bacteriological data:		
Organisms per cc on plain agar after 48 hours at 37° C	170	
Organisms per cc on neutral red agar after 48 hours at 37° C	0	
Gas-forming organisms in 5 cc		......
Gas-forming organisms in 1 cc	+	
Gas-forming organisms in 0.1 cc	0	
Gas-forming organisms in 0.01 cc		......

Belmont Hill Spring is situated at Everett, Mass., and is owned and operated by the Belmont Hill Spring Water Co. It was visited November 30, 1907, samples directly from source being obtained for the examination. The flow was approximately 5 gallons per minute, with a temperature of 52° F. The chemical analysis shows this to be a highly mineralized, calcic, sodic, bicarbonated, nitrated, sulphated water of the alkaline-saline type. The hypothetical combination indicates that of the salts in solution approximately 23 per cent are present as bicarbonate of calcium, 35 per cent as sodium nitrate, 18 per cent as calcium sulphate, and 16 per cent as chlorid and nitrate of magnesium. The sanitary analysis shows the presence of free and albuminoid ammonia, a large amount of nitrates, and the presence of gas-forming organisms in 1-cc quantity. The advertised analysis differs materially from that made in this bureau, the greatest difference being in the content of magnesium, potassium, and nitrates.

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[1] At 0° C. and 760 mm pressure in 1,000 cc of water.

MASSACHUSETTS.

BURNHAM SPRING.

(Alkaline-saline.)

Misc. Div. No. 4833.

Chemical analysis.

Constituents.	Examination by Bureau of Chemistry.			Advertised analysis.
	Amount of water used for each determination.	Analysis.	Total inorganic material in solution.	
IONS.	*Grams.*	*Parts per million.*	*Per cent.*	*Parts per million.*
Phosphoric acid (PO_4)	500	0. 00		
Metaboric acid (BO_2)	500	. 00		
Arsenic acid (AsO_4)	500	. 00		
Silica (SiO_2)	4, 000	13. 70	13. 32	
Sulphuric acid (SO_4)	4, 000	7. 90	7. 68	
Carbonic acid (CO_3)	100	. 00		
Bicarbonic acid (HCO_3)	100	28. 30	27. 52	
Nitric acid (NO_3)	100	11. 05	10. 74	
Nitrous acid (NO_2)	100	Ft. tr.		
Chlorin (Cl)	500	13. 50	13. 13	
Bromin (Br)	1, 000	V. ft. tr.		
Iodin (I)	1, 000	. 00		
Iron (Fe)	4, 000	1. 00	. 97	
Aluminum (Al)				
Manganese (Mn)	4, 000	. 00		
Calcium (Ca)	4, 000	14. 20	13. 81	
Magnesium (Mg)	4, 000	2. 20	2. 14	
Potassium (K)	4, 000	3. 10	3. 01	
Sodium (Na)	4, 000	7. 90	7. 68	
Lithium (Li)	4, 000			
Ammonium (NH_4)	500	Trace.		
Oxygen (calculated) (O)				
Total		102. 85	100. 00	
HYPOTHETICAL COMBINATIONS.				
Ammonium chlorid (NH_4Cl)		Trace.		
Lithium chlorid (LiCl)		V. ft. tr.		
Potassium chlorid (KCl)		5. 90	5. 74	
Potassium bromid (KBr)				
Potassium sulphate (K_2SO_4)				
Sodium nitrate ($NaNO_3$)		15. 15	14. 73	
Sodium nitrite ($NaNO_2$)				
Sodium chlorid (NaCl)		9. 60	9. 33	
Sodium sulphate (Na_2SO_4)				
Sodium bicarbonate ($NaHCO_3$)				
Sodium metaborate ($NaBO_2$)				
Magnesium chlorid ($MgCl_2$)		2. 90	2. 82	
Magnesium bicarbonate ($Mg(HCO_3)_2$)				
Calcium chlorid ($CaCl_2$)		6. 50	6. 32	
Calcium sulphate ($CaSO_4$)		11. 20	10. 89	
Calcium bicarbonate ($Ca(HCO_3)_2$)		34. 70	33. 74	
Calcium phosphate ($Ca_3(PO_4)_2$)				
Ferric oxid (Fe_2O_3)				
Alumina (Al_2O_3)				
Ferrous bicarbonate ($Fe(HCO_3)_2$)		3. 20	3. 11	
Calcium silicate ($CaSiO_3$)				
Silica (SiO_2)		13. 70	13. 32	
Total		102. 85	100. 00	

MASSACHUSETTS.

BURNHAM SPRING.

Misc. Div. No. 4833.

Gases.[1]

	cc
Carbon dioxid (free)	7.1
Carbon dioxid (set free from bicarbonate upon evaporating to dryness)	5.2
Hydrogen sulphid	.0

Sanitary analysis.

	Parts per million.
Ammonia (free)	Trace.
Ammonia albuminoid	0.03
Nitrogen as nitrites	Ft. tr.
Nitrogen as nitrates	2.50
Oxygen required	.07
Bacteriological data:	
Organisms per cc on plain agar after 48 hours at 37° C	0
Organisms per cc on neutral red agar after 48 hours at 37° C	0
Gas-forming organisms in 5 cc	......
Gas-forming organisms in 1 cc	0
Gas-forming organisms in 0.1 cc	0
Gas-forming organisms in 0.01 cc	......

Burnham Spring is situated at Methuen, Mass., and is owned and operated by R. P. Burnham. The spring was visited November 29, 1907, samples being obtained for examination. The flow was said to be approximately 3 gallons per minute, at a temperature of 47° at the holder. The chemical analysis shows this to be a moderately mineralized, calcic, sodic, bicarbonated, muriated, nitrated water of the alkaline-saline type. The hypothetical combination indicates that approximately 37 per cent of the salts in solution are the bicarbonates of calcium and iron, 15 per cent are sodium nitrate, 9 per cent sodium chlorid, and 11 per cent calcium sulphate, with smaller amounts of the chlorids of calcium and magnesium. The sanitary analysis shows a small amount of albuminoid ammonia, faint traces of nitrites, and high nitrates, with an absence of bacteria. No advertised mineral analysis could be obtained for purposes of comparison.

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[1] At 0° C. and 760 more pressure in 1,000 cc of water.

MASSACHUSETTS.

EL AZHAR SPRING.

(Alkaline.)

Misc. Div. No. 4712.

Chemical analysis.

Constituents.	Examination by Bureau of Chemistry.			Advertised analysis.[1]
	Amount of water used for each determination.	Analysis.	Total inorganic material in solution.	
IONS.	*Grams.*	*Parts per million.*	*Per cent.*	*Parts per million.*
Phosphoric acid (PO_4)	500	0.00		
Metaboric acid (BO_2)	500	.00		
Arsenic acid (AsO_4)	500	.00		
Silica (SiO_2)	4,000	8.80	23.75	Trace.
Sulphuric acid (SO_4)	4,000	1.70	4.58	4.38
Carbonic acid (CO_3)	100	.00		
Bicarbonic acid (HCO_3)	100	12.10	32.70	5.23
Nitric acid (NO_3)	100	1.54	4.15	
Nitrous acid (NO_2)	100	Ft. tr.		
Chlorin (Cl)	500	3.00	8.10	1.98
Bromin (Br)	1,000	.00		
Iodin (I)	1,000	.00		
Iron (Fe)	4,000	.07	.18	
Aluminum (Al)				
Manganese (Mn)	4,000	.00		
Calcium (Ca)	4,000	2.40	6.47	2.43
Magnesium (Mg)	4,000	.60	1.62	
Potassium (K)	4,000	.90	2.43	Trace.
Sodium (Na)	4,000	5.30	14.32	2.57
Lithium (Li)	4,000	.00		
Ammonium (NH_4)	500	Trace.		
Oxygen (calculated) (O)		.63	1.70	
Total		37.04	100.00	16.59
HYPOTHETICAL COMBINATIONS.				
Ammonium chlorid (NH_4Cl)		Trace.		
Lithium chlorid (LiCl)				
Potassium chlorid (KCl)		1.70	4.57	Trace.
Potassium bromid (KBr)				
Potassium sulphate (K_2SO_4)				
Sodium nitrate ($NaNO_3$)		2.11	5.70	
Sodium nitrite ($NaNO_2$)		Ft. tr.		
Sodium chlorid (NaCl)		3.63	9.80	3.27
Sodium sulphate (Na_2SO_4)		2.50	6.75	3.96
Sodium bicarbonate ($NaHCO_3$)		9.10	24.58	
Sodium metaborate ($NaBO_2$)				
Magnesium chlorid ($MgCl_2$)				
Magnesium bicarbonate ($Mg(HCO_3)_2$)		3.60	9.72	
Calcium chlorid ($CaCl_2$)				
Calcium sulphate ($CaSO_4$)				2.41
Calcium bicarbonate ($Ca(HCO_3)_2$)		3.30	8.90	6.95
Calcium phosphate ($Ca_3(PO_4)_2$)				
Ferric oxid (Fe_2O_3)		.10	.27	
Alumina (Al_2O_3)				
Ferrous bicarbonate ($Fe(HCO_3)_2$)				
Calcium silicate ($CaSiO_3$)		4.60	12.41	
Silica (SiO_2)		6.40	17.30	Trace.
Total		37.04	100.00	16.59

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[1] Made (no date) by State assayer of Massachusetts. Recalculated from original data according to the scheme adopted by the Bureau of Chemistry for purposes of comparison.

MASSACHUSETTS.

EL AZHAR SPRING.

Misc. Div. No. 4712.

Gases.[1]

	cc
Carbon dioxid (free)	6.7
Carbon dioxid (set free from bicarbonate upon evaporating to dryness)	2.2
Hydrogen sulphid	.0

Sanitary analysis.

	Parts per million.
Ammonia, free	Trace.
Ammonia albuminoid	0.065
Nitrogen as nitrites	Ft. tr.
Nitrogen as nitrates	.350
Oxygen required	.040
Bacteriological data:[2]	
Organisms per cc on plain agar after 48 hours at 37° C	
Organisms per cc on neutral red agar after 48 hours at 37° C	
Gas-forming organisms in 5 cc	
Gas-forming organisms in 1 cc	
Gas-forming organisms in 0.1 cc	
Gas-forming organisms in 0.01 cc	

El Azhar Spring is situated at Lowell, Middlesex County, Mass., and is owned and operated by the El Azhar Spring Water Co. It was visited August 30, 1907, samples directly from source being obtained for the examination. This spring has a very large flow and a temperature of 49° F. Chemical analysis shows this to be a very lightly mineralized, sodic, bicarbonated water of the alkaline type. The hypothetical combination indicates that 43 per cent of the salts in solution are in the form of the bicarbonates of sodium, magnesium, and calcium, 6 per cent of sodium nitrate, 10 per cent of sodium chlorid, and 7 per cent of sodium sulphate. The sanitary analysis shows a small amount of albuminoid ammonia, faint traces of nitrites, and low nitrates. The advertised analysis quoted above is incomplete and is of little value for purposes of comparison.

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[1] At 0° C. and 760 mm pressure in 1,000 cc of water.

[2] No bacteriological samples taken.

MASSACHUSETTS.

GOULDING SPRING.

(Alkaline-saline.)

Misc. Div. No. 2421.

Chemical analysis.

Constituents.	Examination by Bureau of Chemistry.			Advertised analysis.
	Amount of water used for each determination.	Analysis.	Total inorganic material in solution.	
IONS.	*Grams.*	*Parts per million.*	*Per cent.*	*Parts per million.*
Phosphoric acid (PO_4)	500	0.00		
Metaboric acid (BO_2)	500	V. ft. tr.		
Arsenic acid (AsO_4)	500	.00		
Silica (SiO_2)	10,000	19.90	22.40	
Sulphuric acid (SO_4)	4,000	4.30	4.84	
Carbonic acid (CO_3)	100	.00		
Bicarbonic acid (HCO_3)	100	21.10	23.75	
Nitric acid (NO_3)	100	11.00	12.38	
Nitrous acid (NO_2)	50	.00		
Chlorin (Cl)	250	12.35	13.90	
Bromin (Br)	500	.00		
Iodin (I)	500	.00		
Iron (Fe) Aluminum (Al)	1,000	.77	.87	
Manganese (Mn)	1,000	.00		
Calcium (Ca)	4,000	5.80	6.53	
Magnesium (Mg)	4,000	3.10	3.49	
Potassium (K)	4,000	1.40	1.57	
Sodium (Na)	4,000	8.80	9.90	
Lithium (Li)	4,000	.00		
Ammonium (NH_4)	500	Trace.		
Oxygen (calculated) (O)		.33	.37	
Total		88.85	100.00	
HYPOTHETICAL COMBINATIONS.				
Ammonium chlorid (NH_4Cl)		Trace.		
Lithium chlorid (LiCl)		.00		
Potassium chlorid (KCl)		2.65	2.98	
Potassium bromid (KBr)				
Potassium sulphate (K_2SO_4)				
Sodium nitrate ($NaNO_3$)		15.10	16.99	
Sodium nitrite ($NaNO_2$)				
Sodium chlorid (NaCl)		11.90	13.39	
Sodium sulphate (Na_2SO_4)				
Sodium bicarbonate ($NaHCO_3$)				
Sodium metaborate ($NaBO_2$)				
Magnesium chlorid ($MgCl_2$)		5.20	5.85	
Magnesium bicarbonate ($Mg(HCO_3)_2$)		4.20	4.73	
Magnesium sulphate ($MgSO_4$)		5.40	6.08	
Calcium sulphate ($CaSO_4$)				
Calcium bicarbonate ($Ca(HCO_3)_2$)		23.40	26.34	
Calcium phosphate ($Ca_3(PO_4)_2$)				
Ferric oxid (Fe_2O_3) Alumina (Al_2O_3)		1.10	1.24	
Ferrous bicarbonate ($Fe(HCO_3)_2$)				
Calcium silicate ($CaSiO_3$)				
Silica (SiO_2)		19.90	22.40	
Total		88.85	100.00	

MASSACHUSETTS.

GOULDING SPRING.

Misc. Div. No. 2421.

Gases.[1]

	cc
Carbon dioxid (free)	4. 2
Carbon dioxid (set free from bicarbonate upon evaporating to dryness)	3. 9
Hydrogen sulphid	. 0

Sanitary analysis.

	Parts per million.
Ammonia, free	Trace.
Ammonia albuminoid	0. 025
Nitrogen as nitrites	. 000
Nitrogen as nitrates	2. 500
Oxygen required	. 000
Bacteriological data:	
Organisms per cc on plain agar after 48 hours at 37° C	0
Organisms per cc on neutral red agar after 48 hours at 37° C	0
Gas-forming organisms in 5 cc	......
Gas-forming organisms in 1 cc	0
Gas-forming organisms in 0.1 cc	0
Gas-forming organisms in 0.01 cc	......

Goulding Spring is situated about 1 mile from Whitman, Mass., and is owned and operated by Goulding Bros. The spring was visited December 3, 1907, samples directly from source being obtained for examination. The flow was approximately 3 gallons per minute, with a temperature of 50° F. Chemical analysis shows this to be a moderately mineralized, sodic, calcic, bicarbonated, muriated, nitrated water of the alkaline-saline type. Hypothetical combination indicates that approximately 31 per cent of the salts in solution are in the form of the bicarbonates of calcium and magnesium, 17 per cent of sodium nitrate, 13 per cent of sodium chlorid, and small amounts of the chlorid and sulphate of magnesium. Sanitary analysis shows only a small amount of albuminoid ammonia and quite a large amount of nitrate, but an absence of bacteria. No advertised analysis could be obtained for purposes of comparison.

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[1] At 0° C. and 760 mm pressure in 1,000 cc of water.

MASSACHUSETTS.

HIGHLAND SPRING.

(Alkaline-saline.)

Misc. Div. No. 4713.

Chemical analysis.

Constituents.	Examination by Bureau of Chemistry.			Advertised analysis.
	Amount of water used for each determination.	Analysis.	Total inorganic material in solution.	
IONS.	*Grams.*	*Parts per million.*	*Per cent*	*Parts per million.*
Phosphoric acid (PO_4)	500	0. 00		
Metaboric acid (BO_2)	500	. 00		
Arsenic acid (AsO_4)	500	. 00		
Silica (SiO_2)	4, 000	12. 50	17. 60	
Sulphuric acid (SO_4)	4, 000	4. 60	6. 48	
Carbonic acid (CO_3)	100	. 00		
Bicarbonic acid (HCO_3)	100	20. 20	28. 44	
Nitric acid (NO_3)	100	8. 82	12. 42	
Nitrous acid (NO_2)	100	Trace.		
Chlorin (Cl)	500	7. 90	11. 13	
Bromin (Br)	1, 000	. 00		
Iodin (I)	1, 000	. 00		
Iron (Fe) Aluminum (Al)	4, 000	. 40	. 56	
Mangansee (Mn)	4, 000	. 00		
Calcium (Ca)	4, 000	5. 70	8. 03	
Magnesium (Mg)	4, 000	1. 60	2. 25	
Potassium (K)	4, 000	1. 80	2. 53	
Sodium (Na)	4, 000	7. 50	10. 56	
Lithium (Li)	4, 000	. 00		
Ammonium (NH_4)	500	Trace.		
Oxygen (calculated) (O)				
Total		71. 02	100. 00	
HYPOTHETICAL COMBINATIONS.				
Ammonium chlorid (NH_4Cl)		Trace.		
Lithium chlorid (LiCl)		. 00		
Potassium chlorid (KCl)		3. 40	4. 79	
Potassium bromid (KBr)				
Potassium sulphate (K_2SO_4)				
Sodium nitrate ($NaNO_3$)		12. 12	17. 08	
Sodium nitrite ($NaNO_2$)		Trace.		
Sodium chlorid (NaCl)		10. 50	14. 78	
Magnesium sulphate ($MgSO_4$)		5. 80	8. 17	
Sodium bicarbonate ($NaHCO_3$)				
Sodium metaborate ($NaBO_2$)				
Magnesium chlorid ($MgCl_2$)				
Magnesium bicarbonate ($Mg(HCO_3)_2$)		2. 40	3. 38	
Calcium chlorid ($CaCl_2$)				
Calcium sulphate ($CaSO_4$)				
Calcium bicarbonate ($Ca(HCO_3)_2$)		23. 00	32. 37	
Calcium phosphate ($Ca_3(PO_4)_2$)				
Ferric oxid (Fe_2O_3)				
Alumina (Al_2O_3)				
Ferrous bicarbonate ($Fe(HCO_3)_2$)		1. 30	1. 83	
Calcium silicate ($CaSiO_3$)				
Silica (SiO_2)		12. 50	17. 60	
Total		71. 02	100. 00	

MASSACHUSETTS.

HIGHLAND SPRING.

Misc. Div. No. 4713.

Gases.[1]

	cc
Carbon dioxid (free)	5. 0
Carbon dioxid (set free from bicarbonate upon evaporating to dryness)	3. 9
Hydrogen sulphid	. 0

Sanitary analysis.

	Parts per million.
Ammonia, free	Trace.
Ammonia albuminoid	0. 081
Nitrogen as nitrites	Trace.
Nitrogen as nitrates	2. 000
Oxygen required	. 140
Bacteriological data:	
Organisms per cc on plain agar after 48 hours at 37° C	0
Organisms per cc on neutral red agar after 48 hours at 37° C	0
Gas-forming organisms in 5 cc	......
Gas-forming organisms in 1 cc	0
Gas-forming organisms in 0.1 cc	0
Gas-forming organisms in 0.01 cc	......

Highland Spring is situated at West Abbington, Mass., and is operated by J. W. Dooten. It was inspected December 3, 1907, samples directly from source being obtained for the examination. The flow was approximately 5 gallons per minute, with a temperature of 50° F. Chemical analysis shows this to be a lightly mineralized, sodic, calcic, bicarbonated, nitrated, muriated water of the alkaline-saline type. The hypothetical combination indicates that approximately 36 per cent of the salts in solution are in the form of the bicarbonates of calcium and magnesium, 17 per cent of sodium nitrate, 15 per cent of sodium chlorid, and 8 per cent of magnesium sulphate. Sanitary analysis shows a small quantity of albuminoid ammonia, with traces of nitrites, also a considerable amount of nitrates, and an absence of bacteria. Inspection of the premises failed to reveal any probable source of pollution. No advertised mineral analysis could be obtained for purposes of comparison.

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[1] At 0° C. and 760 mm pressure in 1,000 cc of water.

MASSACHUSETTS.

KATAHDIN SPRING.

(Alkaline-saline.)

Misc. Div. No. 4836.

Chemical analysis.

Constituents.	Examination by Bureau of Chemistry.			Advertised analysis.
	Amount of water used for each determination.	Analysis.	Total inorganic material in solution.	
IONS.	*Grams.*	*Parts per million.*	*Per cent.*	*Parts per million.*
Phosphoric acid (PO_4)				
Metaboric acid (BO_2)				
Arsenic acid (AsO_4)				
Silica (SiO_2)	2,000	11.50	7.20	
Sulphuric acid (SO_4)	2,000	10.10	6.32	
Carbonic acid (CO_3)	100	.00		
Bicarbonic acid (HCO_3)	100	27.20	17.03	
Nitric acid (NO_3)	100	49.11	30.74	
Nitrous acid (NO_2)	100	Ft. tr.		
Chlorin (Cl)	500	16.20	10.14	
Bromin (Br)	1,000	V. ft. tr.		
Iodin (I)	1,000	.00		
Iron (Fe) } Aluminum (Al) }	2,000	.30	.19	
Manganese (Mn)	2,000			
Calcium (Ca)	2,000	19.30	12.08	
Magnesium (Mg)	2,000	5.80	3.63	
Potassium (K)	2,000	4.80	3.00	
Sodium (Na)	2,000	13.30	8.33	
Lithium (Li)	2,000	.00		
Ammonium (NH_4)	500	Trace.		
Oxygen (calculated) (O)		2.13	1.34	
Total		159.74	100.00	
HYPOTHETICAL COMBINATIONS.				
Ammonium chlorid (NH_4Cl)		Trace.		
Lithium chlorid (LiCl)		.00		
Potassium chlorid (KCl)				
Potassium bromid (KBr)				
Potassium sulphate (K_2SO_4)				
Sodium nitrate ($NaNO_3$)		49.10	30.73	
Sodium nitrite ($NaNO_2$)		St. tr.		
Potassium nitrate (KNO_3)		12.41	7.77	
Sodium sulphate (Na_2SO_4)				
Magnesium nitrate ($Mg(NO_3)_2$)		6.80	4.26	
Sodium metaborate ($NaBO_2$)				
Magnesium chlorid ($MgCl_2$)		18.40	11.52	
Magnesium bicarbonate ($Mg(HCO_3)_2$)				
Calcium chlorid ($CaCl_2$)		3.90	2.44	
Calcium sulphate ($CaSO_4$)		14.20	8.89	
Calcium bicarbonate ($Ca(HCO_3)_2$)		36.20	22.67	
Calcium phosphate ($Ca_3(PO_4)_2$)				
Ferric oxid (Fe_2O_3) } Alumina (Al_2O_3) }		.43	.27	
Ferrous bicarbonate ($Fe(HCO_3)_2$)				
Calcium silicate ($CaSiO_3$)		13.90	8.70	
Silica (SiO_2)		4.40	2.75	
Total		159.74	100.00	

MASSACHUSETTS.

KATAHDIN SPRING.

Misc. Div. No. 4836.

Gases.[1]

	cc
Carbon dioxid (free)	7.3
Carbon dioxid (set free from bicarbonate upon evaporating to dryness)	5.0
Hydrogen sulphid	.0

Sanitary analysis.

	Parts per million.
Ammonia, free	Trace.
Ammonia albuminoid	0.020
Nitrogen as nitrites	Ft. tr.
Nitrogen as nitrates	11.110
Oxygen required	.300
Bacteriological data:	
Organisms per cc on plain agar after 48 hours at 37° C	15
Organisms per cc on neutral red agar after 48 hours at 37° C	65
Gas-forming organisms in 5 cc	......
Gas-forming organisms in 1 cc	+
Gas-forming organisms in 0.1 cc	......
Gas-forming organisms in 0.01 cc	......

Katahdin Spring is located 2 miles from Lexington, Mass., and is owned and operated by the Katahdin Spring Water Co. It was inspected November 30, 1907, samples directly from source being obtained for the examination. The flow was approximately 10 gallons per minute, with a temperature of 48° F. Chemical analysis shows this to be a highly mineralized, calcic, sodic, nitrated, muriated, bicarbonated water of the alkaline-saline type. The hypothetical combination indicates that approximately 43 per cent of the salts in solution are in the form of the nitrates of sodium, potassium, and magnesium, 12 per cent of chlorid of magnesium, and 23 per cent of calcium bicarbonate; also small quantities of calcium chlorid. The sanitary analysis shows only small amounts of albuminoid ammonia and faint traces of nitrites. The nitrates are, however, unusually high, and while the bacterial count is low, gas-forming organisms were found in 1-cc quantities. These facts indicate that the water is of doubtful purity, while inspection of the premises showed the possibility of contamination of the spring during freshets or wet weather by surface drainage. No advertised analysis of this water could be obtained for purposes of comparison.

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[1] At 0° C., 760 mm pressure in 1,000 cc of water.

MASSACHUSETTS.

LOVERS' LEAP SPRING.

(Saline.)

Misc. Div. No. 4709.

Chemical analysis.

Constituents.	Examination by Bureau of Chemistry.			Advertised analysis.[1]
	Amount of water used for each determination.	Analysis.	Total inorganic material in solution.	
IONS.	*Grams.*	*Parts per million.*	*Per cent.*	*Parts per million.*
Phosphoric acid (PO_4)	500	0.00		
Metaboric acid (BO_2)	500	.00		
Arsenic acid (AsO_4)	500	.00		
Silica (SiO_2)	4,000	11.50	9.57	
Sulphuric acid (SO_4)	4,000	14.10	11.73	
Carbonic acid (CO_3)	100	.00		
Bicarbonic acid (HCO_3)	100	18.20	15.14	
Nitric acid (NO_3)	100	24.50	20.38	
Nitrous acid (NO_2)	100	.00		
Chlorin (Cl)	500	17.20	14.31	
Bromin (Br)	1,000	Trace.		
Iodin (I)	4,000	.00		
Iron (Fe) Aluminum (Al)	4,000	1.60	1.33	
Manganese (Mn)	4,000	.00		
Calcium (Ca)	4,000	11.70	9.73	
Magnesium (Mg)	4,000	3.30	2.75	
Potassium (K)	4,000	2.40	2.00	
Sodium (Na)	4,000	14.40	11.98	
Lithium (Li)	4,000	.00		
Ammonium (NH_4)	500	Trace.		
Oxygen (calculated) (O)		1.30	1.08	
Total		120.20	100.00	
HYPOTHETICAL COMBINATIONS.				
Ammonium chlorid (NH_4Cl)		Trace.		
Lithium chlorid (LiCl)				
Potassium chlorid (KCl)		4.60	3.83	
Potassium bromid (KBr)				
Potassium sulphate (K_2SO_4)				
Sodium nitrate ($NaNO_3$)		33.50	27.87	
Sodium nitrite ($NaNO_2$)				
Sodium chlorid (NaCl)		13.70	11.40	
Sodium sulphate (Na_2SO_4)				
Sodium bicarbonate ($NaHCO_3$)				
Magnesium sulphate ($MgSO_4$)		4.90	4.08	
Magnesium chlorid ($MgCl_2$)		9.00	7.49	
Magnesium bicarbonate ($Mg(HCO_3)_2$)				
Calcium chlorid ($CaCl_2$)				
Calcium sulphate ($CaSO_4$)		14.40	11.98	
Calcium bicarbonate ($Ca(HCO_3)_2$)		24.20	20.13	
Calcium phosphate ($Ca_3(PO_4)_2$)				
Ferric oxid (Fe_2O_3)		2.30	1.91	
Alumina (Al_2O_3)				
Ferrous bicarbonate ($Fe(HCO_3)_2$)				
Calcium silicate ($CaSiO_3$)		4.40	3.66	
Silica (SiO_2)		9.20	7.65	
Total		120.20	100.00	

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[1] Made (no date) by Henry Carmichael. Recalculated from original data according to the scheme adopted by the Bureau of Chemistry, for purposes of comparison.

MASSACHUSETTS.

LOVERS' LEAP SPRING.

Misc. Div. No. 4709.

Gases.[1]

	cc
Carbon dioxid (free)	8. 9
Carbon dioxid (set free from bicarbonate upon evaporating to dryness)	3. 4
Hydrogen sulphid	. 0

Sanitary analysis.

	Parts per million.
Ammonia, free	Trace.
Ammonia albuminoid	0. 06
Nitrogen as nitrites	. 00
Nitrogen as nitrates	5. 55
Oxygen required	2. 07
Bacteriological data:	
Organisms per cc on plain agar after 48 hours at 37° C	0
Organisms per cc on neutral red agar after 48 hours at 37° C	0
Gas-forming organisms in 5 cc	......
Gas-forming organisms in 1 cc	0
Gas-forming organisms in 0.1 cc	0
Gas-forming organisms in 0.01 cc	......

Lovers' Leap Spring is situated at Lynn, Mass., and is owned by the Lovers' Leap Spring Water Co. The spring was visited November 30, 1907, samples directly from source being obtained for examination. The flow was approximately 40 gallons per hour, with a temperature of 45° F. The chemical analysis shows this to be a moderately mineralized, sodic, calcic, nitrated, muriated, sulphated water of the saline type. The hypothetical combination indicates that, of the salts in solution, approximately 20 per cent are present as bicarbonate of calcium, 28 per cent as sodium nitrate, 11 per cent as sodium chlorid, 12 per cent as calcium sulphate, and 12 per cent as sulphate and chlorid of magnesium. The sanitary analysis shows a small amount of albuminoid ammonia, a large amount of nitrates, and the absence of bacteria.

In a recent letter the spring water company reports that they have discontinued the use of the water from this spring for commercial purposes, owing to a decrease in the supply, and that they are developing a new spring which they have named the Lovers' Leap Deep Glen Spring, one-fourth of a mile from the old Lovers' Leap Spring. A sample of this water will be obtained for analysis and the results will appear in a future publication.

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[1] At 0° C. and 760 mm pressure in 1,000 cc of water.

MASSACHUSETTS.

NOBSCOT MOUNTAIN SPRING.

(Alkaline.)

Misc. Div. No. 4711.

Chemical analysis.

Constituents.	Examination by Bureau of Chemistry.			Advertised analysis.[1]
	Amount of water used for each determination.	Analysis.	Total inorganic material in solution.	
IONS.	*Grams.*	*Parts per million.*	*Per cent.*	*Parts per million.*
Phosphoric acid (PO_4)	500	0.00		
Metaboric acid (BO_2)	500	Trace.		
Arsenic acid (AsO_4)	500	.00		
Silica (SiO_2)	4,000	10.70	20.21	9.12
Sulphuric acid (SO_4)	4,000	3.50	6.61	2.84
Carbonic acid (CO_3)	100	.00		
Bicarbonic acid (HCO_3)	100	21.20	40.04	28.98
Nitric acid (NO_3)	100	.55	1.04	
Nitrous acid (NO_2)	100	Ft. tr.		
Chlorin (Cl)	500	2.80	5.29	3.75
Bromin (Br)	1,000	Trace.		
Iodin (I)	1,000	.00		
Iron (Fe)	4,000	1.20	2.26	.27
Aluminum (Al)				
Manganese (Mn)	4,000	.00		
Calcium (Ca)	4,000	5.40	10.20	5.17
Magnesium (Mg)	4,000	1.00	1.89	1.14
Potassium (K)	4,000	1.20	2.27	2.32
Sodium (Na)	4,000	4.40	8.31	5.28
Lithium (Li)	4,000	.00		
Ammonium (NH_4)	500	Trace.		Trace.
Oxygen (calculated) (O)		1.00	1.88	.07
Total		52.95	100.00	58.94
HYPOTHETICAL COMBINATIONS.				
Ammonium chlorid (NH_4Cl)		Trace.		Trace.
Lithium chlorid (LiCl)				
Potassium chlorid (KCl)		2.30	4.34	4.42
Potassium bromid (KBr)		Trace.		
Potassium sulphate (K_2SO_4)				
Sodium nitrate ($NaNO_3$)		.75	1.42	
Sodium nitrite ($NaNO_2$)		Ft. tr.		
Sodium chlorid (NaCl)		2.80	5.29	2.72
Sodium sulphate (Na_2SO_4)		5.20	9.82	4.20
Sodium bicarbonate ($NaHCO_3$)		5.10	9.63	10.39
Sodium metaborate ($NaBO_2$)		Trace.		
Magnesium chlorid ($MgCl_2$)				
Magnesium bicarbonate ($Mg(HCO_3)_2$)		6.00	11.33	6.85
Calcium chlorid ($CaCl_2$)				
Calcium sulphate ($CaSO_4$)				
Calcium bicarbonate ($Ca(HCO_3)_2$)		16.60	31.35	20.90
Calcium phosphate ($Ca_3(PO_4)_2$)				
Ferric oxid (Fe_2O_3)		1.70	3.21	.34
Alumina (Al_2O_3)				
Ferrous bicarbonate ($Fe(HCO_3)_2$)				
Calcium silicate ($CaSiO_3$)		3.80	7.18	
Silica (SiO_2)		8.70	16.43	9.12
Total		52.95	100.00	58.94

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[1] Made in 1891 by Davenport and Williams. Recalculated from original data, according to the scheme adopted by the Bureau of Chemistry, for purposes of comparison.

MASSACHUSETTS.

NOBSCOT MOUNTAIN SPRING.

Misc. Div. No. 4711.

Gases.[1]

	cc
Carbon dioxid (free)	8.4
Carbon dioxid (set free from bicarbonate upon evaporating to dryness)	3.9
Hydrogen sulphid	.0

Sanitary analysis.

	Parts per million.
Ammonia, free	Trace.
Ammonia albuminoid	0.038
Nitrogen as nitrites	Ft. tr.
Nitrogen as nitrates	.125
Oxygen required	.190
Bacteriological data:	
Organisms per cc on plain agar after 48 hours at 37° C	0
Organisms per cc on neutral red agar after 48 hours at 37° C	0
Gas-forming organisms in 5 cc	....
Gas-forming organisms in 1 cc	0
Gas-forming organisms in 0.1 cc	0
Gas-forming organisms in 0.01 cc	....

Nobscot Mountain Spring is situated near Framingham, Mass., and is owned and operated by the Nobscot Mountain Spring Co. It was visited December 1, 1907, samples directly from source being obtained for the examination. The flow was approximately 1,000 gallons per hour, with a temperature of 49°F. Chemical analysis shows this to be a lightly mineralized, calcic, sodic, bicarbonated water of the alkaline type. The hypothetical combination indicates that approximately 52 per cent of the salts in solution are in the form of the bicarbonates of calcium, magnesium, and sodium, with 10 per cent of sodium sulphate and 5 per cent of sodium chlorid. Sanitary analysis shows a small amount of albuminoid ammonia, faint traces of nitrities, low nitrites, and an absence of bacteria, which indicates organic purity. Inspection of the premises failed to reveal any probable source of pollution. The advertised analysis made in 1891 agrees very well with the analysis made by this bureau.

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[1] At 0° C. and 760 mm pressure in 1,000 cc of water.

MASSACHUSETTS.

ROBBINS SPRING.

(Alkaline-saline.)

Misc. Div. No. 4714.

Chemical analysis.

Constituents.	Examination by Bureau of Chemistry.			Advertised analysis.
	Amount of water used for each determination.	Analysis.	Total inorganic material in solution.	
Ions.	*Grams.*	*Parts per million.*	*Per cent.*	*Parts per million.*
Phosphoric acid (PO_4)	500	0.00	....	....
Metaboric acid (BO_2)	500	.00	....	....
Arsenic acid (AsO_4)	500	.00	....	....
Silica (SiO_2)	4,000	10.60	14.82	....
Sulphuric acid (SO_4)	4,000	9.20	12.86	....
Carbonic acid (CO_3)	100	.00	....	....
Bicarbonic acid (HCO_3)	100	21.20	29.65	....
Nitric acid (NO_3)	100	6.18	8.64	....
Nitrous acid (NO_2)	100	.00	....	....
Chlorin (Cl)	500	7.10	9.93	....
Bromin (Br)	1,000	.00	....	....
Iodin (I)	1,000	.00	....	....
Iron (Fe)	4,000	.30	.42	....
Aluminum (Al)				....
Manganese (Mn)	....	....	....	....
Calcium (Ca)	4,000	7.00	9.79	....
Magnesium (Mg)	4,000	2.50	3.50	....
Potassium (K)	4,000	.90	1.26	....
Sodium (Na)	4,000	6.10	8.53	....
Lithium (Li)	4,000	.00	....	....
Ammonium (NH_4)	500	Trace.	....	....
Oxygen (calculated) (O)	....	.43	.60	....
Total	....	71.51	100.00	....
Hypothetical Combinations.				
Ammonium chlorid (NH_4Cl)	....	Trace.	....	....
Lithium chlorid (LiCl)	....	.00	....	....
Potassium chlorid (KCl)	....	1.90	2.66	....
Potassium bromid (KBr)	....	....	....	....
Potassium sulphate (K_2SO_4)	....	....	....	....
Sodium nitrate ($NaNO_3$)	....	8.48	11.86	....
Sodium nitrite ($NaNO_2$)	....	....	....	....
Sodium chlorid (NaCl)	....	9.90	13.85	....
Magnesium sulphate ($MgSO_4$)	....	11.50	16.08	....
Sodium bicarbonate ($NaHCO_3$)	....	....	....	....
Sodium metaborate ($NaBO_2$)	....	....	....	....
Magnesium chlorid ($MgCl_2$)	....	....	....	....
Magnesium bicarbonate ($Mg(HCO_3)_2$)	....	1.20	1.68	....
Calcium chlorid ($CaCl_2$)	....	....	....	....
Calcium sulphate ($CaSO_4$)	....	....	....	....
Calcium bicarbonate ($Ca(HCO_3)_2$)	....	26.60	37.20	....
Calcium phosphate ($Ca_3(PO_4)_2$)	....	....	....	....
Ferric oxid (Fe_2O_3)	....	.43	.60	....
Alumina (Al_2O_3)				....
Ferrous bicarbonate ($Fe(HCO_3)_2$)	....	....	....	....
Calcium silicate ($CaSiO_3$)	....	1.70	2.37	....
Silica (SiO_2)	....	9.80	13.70	....
Total	....	71.51	100.00	....

MASSACHUSETTS.

ROBBINS SPRING.

Misc. Div. No. 4714.

Gases.[1]

	cc
Carbon dioxid (free)	8.4
Carbon dioxid (set free from bicarbonate upon evaporating to dryness)	3.9
Hydrogen sulphid	.0

Sanitary analysis.

	Parts per million.
Ammonia, free	Trace.
Ammonia albuminoid	0.07
Nitrogen as nitrites	.00
Nitrogen as nitrates	1.40
Oxygen required	.19
Bacteriological data:	
Organisms per cc on plain agar after 48 hours at 37° C	2
Organisms per cc on neutral red agar after 48 hours at 37° C	2
Gas-forming organisms in 5 cc	......
Gas-forming organisms in 1 cc	0
Gas-forming organisms in 0.1 cc	0
Gas-forming organisms in 0.01 cc	......

Robbins Spring is situated at Arlington Heights, Middlesex County, Mass., and is owned and operated by Robbins Spring Water Co. It was inspected November 30, 1907, samples directly from source being obtained for the purpose of examination. The flow was approximately 5 gallons per minute, with a temperature of 46° F. Chemical analysis shows this to be a lightly mineralized, calcic, sodic, bicarbonated, sulphated, muriated, nitrated water of the alkaline-saline type. The hypothetical combination indicates that approximately 39 per cent of the salts in solution are in the form of the bicarbonates of calcium and magnesium, with 12 per cent of sodium nitrate, 14 per cent of sodium chlorid, and 16 per cent of magnesium sulphate. The sanitary analysis shows traces of free ammonia, a small amount of albuminoid ammonia, and considerable nitrate; the bacterial count, however, is low and inspection of the premises failed to reveal any probable sources of pollution. No advertised chemical analysis of the water could be obtained for the purpose of comparison.

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[1] At 0° C. and 760 mm pressure in 1,000 cc of water.

MASSACHUSETTS.

SAND SPRING.

(Alkaline.)

Misc. Div. No. 4708.

Chemical analysis.

Constituents.	Examination by Bureau of Chemistry.			Advertised analysis.[1]
	Amount of water used for each determination.	Analysis.	Total inorganic material in solution.	
IONS.	*Grams.*	*Parts per million.*	*Per cent.*	*Parts per million.*
Phosphoric acid (PO_4)	500	Trace.		
Metaboric acid (BO_2)	500	Trace.		
Arsenic acid (AsO_4)	500	0.00		
Silica (SiO_2)	4,000	21.70	11.12	12.08
Sulphuric acid (SO_4)	4,000	9.70	4.97	8.81
Carbonic acid (CO_3)	100	.00		4.51
Bicarbonic acid (HCO_3)	100	118.00	60.47	79.13
Nitric acid (NO_3)	100	.66	.34	.67
Nitrous acid (NO_2)	50	.00		.00
Chlorin (Cl)	500	3.20	1.64	1.31
Bromin (Br)	1,000	.00		
Iodin (I)	1,000	.00		
Iron (Fe)	4,000	2.40	1.23	.09
Aluminum (Al)				.30
Manganese (Mn)	4,000	.00		
Calcium (Ca)	4,000	24.18	12.39	17.41
Magnesium (Mg)	4,000	8.20	4.20	7.58
Potassium (K)	4,000	1.80	.92	
Sodium (Na)	4,000	5.30	2.72	3.99
Lithium (Li)	4,000	.00		.10
Ammonium (NH_4)	500	Trace.		.00
Oxygen (calculated) (O)				.30
Total		195.14	100.00	136.28
HYPOTHETICAL COMBINATIONS.				
Ammonium chlorid (NH_4Cl)		Trace.		
Lithium chlorid (LiCl)		.00		.61
Potassium chlorid (KCl)		3.43	1.75	
Potassium bromid (KBr)				
Potassium sulphate (K_2SO_4)				
Sodium nitrate ($NaNO_3$)		.91	.47	.92
Sodium nitrite ($NaNO_2$)				
Sodium chlorid (NaCl)		2.69	1.38	1.32
Sodium sulphate (Na_2SO_4)		12.12	6.21	9.93
Sodium bicarbonate ($NaHCO_3$)				
Magnesium sulphate ($MgSO_4$)		1.89	.97	2.63
Magnesium carbonate ($MgCO_3$)				6.34
Magnesium bicarbonate ($Mg(HCO_3)_2$)		46.99	24.08	31.37
Calcium chlorid ($CaCl_2$)				
Calcium sulphate ($CaSO_4$)				
Calcium bicarbonate ($Ca(HCO_3)_2$)		97.77	50.10	70.39
Calcium phosphate ($Ca_3(PO_4)_2$)				
Ferric oxid (Fe_2O_3)				.13
Alumina (Al_2O_3)				.56
Ferrous bicarbonate ($Fe(HCO_3)_2$)		7.64	3.92	
Calcium silicate ($CaSiO_3$)				
Silica (SiO_2)		21.70	11.12	12.08
Total		195.14	100.00	136.28

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[1] Made in 1896 by Leverett H. Mears. Recalculated, for purposes of comparison, from original data according to the scheme adopted by the Bureau of Chemistry.

MASSACHUSETTS.

SAND SPRING.

Misc. Div. No. 4708.

Gases.[1]

	cc
Carbon dioxid (free)	0.8
Carbon dioxid (set free from bicarbonate upon evaporating to dryness)	21.6
Hydrogen sulphid	.0

Sanitary analysis.

	Parts per million.
Ammonia, free	Trace.
Ammonia albuminoid	0.096
Nitrogen as nitrites	.000
Nitrogen as nitrates	.150
Oxygen required	
Bacteriological data:	
Organisms per cc on plain agar after 48 hours at 37° C	400
Organisms per cc on neutral red agar after 48 hours at 37° C	25
Gas-forming organisms in 5 cc	....
Gas-forming organisms in 1 cc	0
Gas-forming organisms in 0.1 cc	0
Gas-forming organisms in 0.01 cc	......

Sand Spring is situated in Berkshire County, near Williamstown, Mass., and is owned by Dr. S. L. Loyd. It was inspected November 30, 1907, samples directly from source being obtained for the examination. The flow was said to be 400 gallons per minute and at the time of inspection the temperature was 76° F. This is a thermal water and the only hot spring inspected in the New England States. Chemical analysis shows it to be a moderately mineralized, calcic, bicarbonated water of the alkaline type. The hypothetical combination indicates that approximately 78 per cent of the salts in solution are in the form of the bicarbonates of calcium, magnesium, and iron, with a small amount of the sulphates of sodium and magnesium and the chlorids of sodium and potassium. The sanitary analysis shows a small amount of albuminoid ammonia and nitrates, while the bacterial count, though slightly high, is not abnormally so. Inspection of the premises failed to reveal any probable source of pollution. The advertised analysis made in 1896 shows less salts in solution than were found in the sample examined by the Bureau of Chemistry.

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[1] At 0° C. and 760 mm pressure in 1,000 cc of water.

MASSACHUSETTS.

SIMPSON SPRING.

(Alkaline-saline.)

Misc. Div. No. 4710.

Chemical analysis.

Constituents.	Examination by Bureau of Chemistry.			Advertised analysis.[1]
	Amount of water used for each determination.	Analysis.	Total inorganic material in solution.	
IONS.	*Grams.*	*Parts per million.*	*Per cent.*	*Parts per million.*
Phosphoric acid (PO_4)	500	0.00		
Metaboric acid (BO_2)	500	.00		
Arsenic acid (AsO_4)	500	.00		
Silica (SiO_2)	4,000	2.30	5.11	
Sulphuric acid (SO_4)	4,000	4.80	10.66	
Carbonic acid (CO_3)	100	.00		
Bicarbonic acid (HCO_3)	100	15.00	33.33	
Nitric acid (NO_3)	100	2.21	4.91	
Nitrous acid (NO_2)	100	.00		
Chlorin (Cl)	500	6.20	13.78	
Bromin (Br)	1,000	V. ft. tr.		
Iodin (I)	1,000	.00		
Iron (Fe) Aluminum (Al)	4,000	.80	1.78	
Manganese (Mn)	4,000	.00		
Calcium (Ca)	4,000	4.20	9.33	
Magnesium (Mg)	4,000	.90	2.00	
Potassium (K)	4,000	1.10	2.45	
Sodium (Na)	4,000	6.70	14.88	
Lithium (Li)	4,000	.00		
Ammonium (NH_4)	500	Trace.		
Oxygen (calculated) (O)		.80	1.77	
Total		45.01	100.00	
HYPOTHETICAL COMBINATIONS.				
Ammonium chlorid (NH_4Cl)		Trace.		
Lithium chlorid (LiCl)		.00		
Potassium chlorid (KCl)		2.10	4.67	
Potassium bromid (KBr)				
Potassium sulphate (K_2SO_4)				
Sodium nitrate ($NaNO_3$)		3.01	6.69	
Sodium nitrite ($NaNO_2$)				
Sodium chlorid (NaCl)		8.60	19.11	
Sodium sulphate (Na_2SO_4)		7.10	15.77	
Sodium bicarbonate ($NaHCO_3$)		.70	1.55	
Sodium metaborate ($NaBO_2$)				
Magnesium chlorid ($MgCl_2$)				
Magnesium bicarbonate ($Mg(HCO_3)_2$)		5.40	12.00	
Calcium chlorid ($CaCl_2$)				
Calcium sulphate ($CaSO_4$)				
Calcium bicarbonate ($Ca(HCO_3)_2$)		13.30	29.55	
Calcium phosphate ($Ca_3(PO_4)_2$)				
Ferric oxid (Fe_2O_3)		1.20	2.66	
Alumina (Al_2O_3)				
Ferrous bicarbonate ($Fe(HCO_3)_2$)				
Calcium silicate ($CaSiO_3$)		2.60	5.78	
Silica (SiO_2)		1.00	2.22	
Total		45.01	100.00	

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[1] Too incomplete to be used for comparison.

MASSACHUSETTS.

SIMPSON SPRING.

Misc. Div. No. 4710.

Gases.[1]

	cc
Carbon dioxid (free)	8.4
Carbon dioxid (set free from bicarbonate upon evaporating to dryness)	2.7
Hydrogen sulphid	.0

Sanitary analysis.

	Parts per million.
Ammonia, free	Trace.
Ammonia albuminoid	0.075
Nitrogen as nitrites	.000
Nitrogen as nitrates	.500
Oxygen required	.160
Bacteriological data:	
Organisms per cc on plain agar after 48 hours at 37° C	1
Organisms per cc on neutral red agar after 48 hours at 37° C	0
Gas-forming organisms in 5 cc	0
Gas-forming organisms in 1 cc	0
Gas-forming organisms in 0.1 cc	0

Simpson Spring is situated at South Easton, Mass., and is owned and operated by the Simpson Spring Water Co. It was visited December 3, 1907, samples directly from source being obtained for the examination. The flow was approximately 10 gallons per minute, with a temperature of 49° F. Chemical analysis shows this to be a lightly mineralized, sodic, calcic, bicarbonated, muriated, sulphated water of the alkaline-saline type. The hypothetical combination indicates that approximately 43 per cent of the salts in solution are in the form of the bicarbonates of calcium, magnesium, and sodium, with 19 per cent of chlorid of sodium, and 16 per cent of sulphate of sodium. The sanitary analysis shows small amounts of albuminoid ammonia and nitrates and a low bacterial count, which indicates organic purity. Inspection of the premises failed to reveal any probable sources of pollution. The advertised chemical analysis is incomplete and is of no value for purposes of comparison.

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[1] At 0° C. and 760 mm pressure in 100 cc of water.

MASSACHUSETTS.

VALPEY SPRING.

(Alkaline-saline.)

Misc. Div. No. 4834.

Chemical analysis.

Constituents.	Examination by Bureau of Chemistry.			Advertised analysis.
	Amount of water used for each determination.	Analysis.	Total inorganic material in solution.	
IONS.	*Grams.*	*Parts per million.*	*Per cent.*	*Parts per million.*
Phosphoric acid (PO_4)	500	0.00		
Metaboric acid (BO_2)	500	.00		
Arsenic acid (AsO_4)	500	.00		
Silica (SiO_2)	4,000	11.00	19.17	
Sulphuric acid (SO_4)	4,000	6.10	10.63	
Carbonic acid (CO_3)	100	.00		
Bicarbonic acid (HCO_3)	100	12.10	21.08	
Nitric acid (NO_3)	100	8.82	15.37	
Nitrous acid (NO_2)	100	Ft. tr.		
Chlorin (Cl)	500	5.80	10.11	
Bromin (Br)	1,000	V. ft. tr.		
Iodin (I)	1,000	.00		
Iron (Fe) Aluminum (Al)	4,000	.40	.70	
Manganese (Mn)	4,000	.00		
Calcium (Ca)	4,000	6.40	11.14	
Magnesium (Mg)	4,000	1.10	1.92	
Potassium (K)	4,000	1.10	1.92	
Sodium (Na)	4,000	4.40	7.66	
Lithium (Li)	4,000	.00		
Ammonium (NH_4)	500	Trace.		
Oxygen (calculated) (O)		.17	.30	
Total		57.39	100.00	
HYPOTHETICAL COMBINATIONS.				
Ammonium chlorid (NH_4Cl)		Trace.		
Lithium chlorid (LiCl)		.00		
Potassium chlorid (KCl)		2.10	3.66	
Potassium bromid (KBr)				
Potassium sulphate (K_2SO_4)				
Sodium nitrate ($NaNO_3$)		12.12	21.12	
Sodium nitrite ($NaNO_2$)				
Sodium chlorid (NaCl)		2.80	4.88	
Sodium sulphate (Na_2SO_4)				
Sodium bicarbonate ($NaHCO_3$)				
Sodium metaborate ($NaBO_2$)				
Magnesium chlorid ($MgCl_2$)		4.20	7.32	
Magnesium bicarbonate ($Mg(HCO_3)_2$)				
Calcium chlorid ($CaCl_2$)				
Calcium sulphate ($CaSO_4$)		8.50	14.81	
Calcium bicarbonate ($Ca(HCO_3)_2$)		16.10	28.05	
Calcium phosphate ($Ca_3(PO_4)_2$)				
Ferric oxid (Fe_2O_3) Alumina (Al_2O_3)		.57	.99	
Ferrous bicarbonate ($Fe(HCO_3)_2$)				
Calcium silicate ($CaSiO_3$)				
Silica (SiO_2)		11.00	19.17	
Total		57.39	100.00	

MASSACHUSETTS.

VALPEY SPRING.

Misc. Div. No. 4834.

Gases.[1]

	cc
Carbon dioxid (free)	6.7
Carbon dioxid (set free from bicarbonate upon evaporating to dryness)	2.2
Hydrogen sulphid	.0

Sanitary analysis.

	Parts per million.
Ammonia, free	Trace.
Ammonia albuminoid	0.034
Nitrogen as nitrites	Ft. tr.
Nitrogen as nitrates	2.00
Oxygen required	.140
Bacteriological data:	
Organisms per cc on plain agar after 48 hours at 37° C	1
Organisms per cc on neutral red agar after 48 hours at 37° C	1
Gas-forming organisms in 5 cc	......
Gas-forming organisms in 1 cc	0
Gas-forming organisms in 0.1 cc	0
Gas-forming organisms in 0.01 cc	......

Valpey Spring is situated at Lawrence, Essex County, Mass., and is owned and operated by F. E. Valpey. The spring was visited November 29, 1907, samples directly from source being obtained for examination. The flow was approximately 4 gallons per minute, with a temperature of 47.5° F. Chemical analysis shows this to be a lightly mineralized, calcic, sodic, bicarbonated, nitrated, sulphated, muriated water of the alkaline-saline type. The hypothetical combination indicates that of the salts in solution approximately 28 per cent are in the form of bicarbonate of calcium, 21 per cent as sodium nitrate, 7 per cent as magnesium chlorid, 15 per cent as calcium sulphate, and smaller amounts as chlorids of potassium and sodium. The sanitary analysis shows small amounts of albuminoid ammonia, and quite a large amount of nitrates, but a very low bacterial count. Inspection of the premises failed to reveal any probable sources of pollution. No advertised mineral analysis could be obtained for purposes of comparison.

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[1] At 0° C. and 760 mm pressure in 1,000 cc of water.

RHODE ISLAND.

GLADSTONE SPRING.

(Alkaline-saline.)

Misc. Div. No. 2423.

Chemical analysis.

Constituents.	Examination by Bureau of Chemistry.			Advertised analysis.
	Amount of water used for each determination.	Analysis.	Total inorganic material in solution.	
IONS.	*Grams.*	*Parts per million.*	*Per cent.*	*Parts per million.*
Phosphoric acid (PO_4)	500	Trace.		
Metaboric acid (BO_2)	500	Trace.		
Arsenic acid (AsO_4)	500	0.00		
Silica (SiO_2)	10,000	15.40	18.00	
Sulphuric acid (SO_4)	4,000	7.60	8.88	
Carbonic acid (CO_3)	100	.00		
Bicarbonic acid (HCO_3)	100	24.70	28.87	
Nitric acid (NO_3)	100	2.70	3.15	
Nitrous acid (NO_2)	50	.00		
Chlorin (Cl)	250	13.96	16.31	
Bromin (Br)	500	.00		
Iodin (I)	500	.00		
Iron (Fe) Aluminum (Al)	1,000	.60	.71	
Manganese (Mn)	1,000	.00		
Calcium (Ca)	4,000	5.50	6.43	
Magnesium (Mg)	4,000	2.60	3.04	
Potassium (K)	4,000	1.70	1.99	
Sodium (Na)	4,000	10.50	12.27	
Lithium (Li)	4,000	.00		
Ammonium (NH_4)	500	Trace.		
Oxygen (calculated) (O)		.30	.35	
Total		85.56	100.00	
HYPOTHETICAL COMBINATIONS.				
Ammonium chlorid (NH_4Cl)		Trace.		
Lithium chlorid (LiCl)		0.00		
Potassium chlorid (KCl)		3.26	3.81	
Potassium bromid (KBr)				
Potassium sulphate (K_2SO_4)				
Sodium nitrate ($NaNO_3$)		3.70	4.32	
Sodium nitrite ($NaNO_2$)				
Sodium chlorid (NaCl)		20.40	23.84	
Sodium sulphate (Na_2SO_4)		5.60	6.54	
Sodium bicarbonate ($NaHCO_3$)				
Magnesium sulphate ($MgSO_4$)		4.50	5.26	
Magnesium chlorid ($MgCl_2$)				
Magnesium bicarbonate ($Mg(HCO_3)_2$)		9.60	11.22	
Calcium chlorid ($CaCl_2$)				
Calcium sulphate ($CaSO_4$)				
Calcium bicarbonate ($Ca(HCO_3)_2$)		22.20	25.94	
Calcium phosphate ($Ca_3(PO_4)_2$)				
Ferric oxid (Fe_2O_3)		.90	1.06	
Alumina (Al_2O_3)				
Ferrous bicarbonate ($Fe(HCO_3)_2$)				
Calcium silicate ($CaSiO_3$)				
Silica (SiO_2)		15.40	18.01	
Total		85.56	100.00	

RHODE ISLAND.

GLADSTONE SPRING.

Misc. Div. No. 2423.

Gases.[1]

	cc
Carbon dioxid (free)	6.9
Carbon dioxid (set free from bicarbonate upon evaporating to dryness)	4.5
Hydrogen sulphid	.0

Sanitary analysis.

	Parts per million.
Ammonia, free	Trace.
Ammonia albuminoid	0.016
Nitrogen as nitrites	.000
Nitrogen as nitrates	.600
Oxygen required	......
Bacteriological data:	
Organisms per cc on plain agar after 48 hours at 37° C	0
Organisms per cc on neutral red agar after 48 hours at 37° C	0
Gas-forming organisms in 5 cc	......
Gas-forming organisms in 1 cc	0
Gas-forming organisms in 0.1 cc	0
Gas-forming organisms in 0.01 cc	......

Gladstone Spring is situated at Narragansett Pier, R. I., and is owned and operated by Miss Mary L. Robinson. The spring was inspected December 5, 1907, samples directly from source being obtained for examination. The flow was said to be approximately 50,000 gallons in 24 hours, at a temperature of 50° F. Chemical analysis shows this to be a moderately mineralized, sodic, calcic, bicarbonated, muriated, sulphated water of the alkaline-saline type. The hypothetical combination indicates that approximately 37 per cent of the salts in solution are in the form of the bicarbonates of calcium and magnesium, and 36 per cent are present as chlorid and sulphate of sodium and magnesium. The sanitary analysis shows a very small amount of ammonia and nitrates, with an absence of bacteria, which indicates organic purity. No advertised analysis was available for purposes of comparison.

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[1] At 0° C. and 760 mm pressure in 1,000 cc of water.

RHODE ISLAND.

HOLLY MINERAL SPRING

(Alkaline.)

Misc. Div. No. 2422.

Chemical analysis.

Constituents.	Examination by Bureau of Chemistry.			Advertised analysis.[1]
	Amount of water used for each determination.	Analysis.	Total inorganic material in solution.	
IONS.	*Grams.*	*Parts per million.*	*Per cent.*	*Parts per million.*
Phosphoric acid (PO_4)	500	Trace.		
Metaboric acid (BO_2)	500	St. tr.		
Arsenic acid (AsO_4)	500	0. 00		
Silica (SiO_2)	10, 000	11. 70	17. 45	10. 32
Sulphuric acid (SO_4)	4, 000	3. 60	5. 37	4. 49
Carbonic acid (CO_3)	100	. 00		
Bicarbonic acid (HCO_3)	100	30. 80	45. 93	15. 41
Nitric acid (NO_3)	100	1. 80	2. 68	
Nitrous acid (NO_2)	50	. 00		
Chlorin (Cl)	250	4. 36	6. 51	3. 55
Bromin (Br)	500	. 00		
Iodin (I)	500	. 00		
Iron (Fe) Aluminum (Al)	1, 000	. 60	. 89	. 36
Manganese (Mn)	1, 000	. 00		
Calcium (Ca)	4, 000	6. 30	9. 39	4. 90
Magnesium (Mg)	4, 000	1. 80	2. 68	1. 24
Potassium (K)	4, 000	. 90	1. 34	
Sodium (Na)	4, 000	5. 20	7. 76	2. 30
Lithium (Li)	4, 000	Ft. tr.		
Ammonium (NH_4)	500	Trace.		
Oxygen (calculated) (O)				. 16
Total		67. 06	100. 00	42. 73
HYPOTHETICAL COMBINATIONS.				
Ammonium chlorid (NH_4Cl)		Trace.		
Lithium chlorid ($LiCl$)		Trace.		
Potassium chlorid (KCl)		1. 70	2. 54	
Potassium bromid (KBr)				
Potassium sulphate (K_2SO_4)				
Sodium nitrate ($NaNO_3$)		2. 50	3. 73	
Sodium nitrite ($NaNO_2$)				
Sodium chlorid ($NaCl$)		5. 86	8. 74	5. 85
Sodium sulphate (Na_2SO_4)		5. 30	7. 90	
Sodium bicarbonate ($NaHCO_3$)		1. 80	2. 68	
Sodium metaborate ($NaBO_2$)		St. tr.		
Magnesium sulphate ($MgSO_4$)				5. 63
Magnesium bicarbonate ($Mg(HCO_3)_2$)		10. 80	16. 10	. 60
Calcium chlorid ($CaCl_2$)				
Calcium sulphate ($CaSO_4$)				
Calcium bicarbonate ($Ca(HCO_3)_2$)		25. 50	38. 02	19. 81
Calcium phosphate ($Ca_3(PO_4)_2$)		Trace.		
Ferric oxid (Fe_2O_3) Alumina (Al_2O_3)		1. 90	2. 83	. 52
Ferrous bicarbonate ($Fe(HCO_3)_2$)				
Calcium silicate ($CaSiO_3$)				
Silica (SiO_2)		11. 70	17. 46	10. 32
Total		67. 06	100. 00	42. 73

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[1] Made in 1883 by Edwin E. Calder. For purposes of comparison, recalculated from original data according to the scheme adopted by the Bureau of Chemistry.

RHODE ISLAND.

HOLLY MINERAL SPRING.

Misc. Div. No. 2422.

Gases.[1]

	cc
Carbon dioxid (free)	8. 90
Carbon dioxid (set free from bicarbonate upon evaporating to dryness)	5. 60
Hydrogen sulphid	. 00

Sanitary analysis.

	Parts per million.
Ammonia, free	Trace.
Ammonia albuminoid	0. 02
Nitrogen as nitrites	. 00
Nitrogen as nitrates	. 40
Oxygen required	......
Bacteriological data :	
Organisms per cc on plain agar after 48 hours at 37° C	0
Organisms per cc on neutral red agar after 48 hours at 37° C	0
Gas-forming organisms in 5 cc	......
Gas-forming organisms in 1 cc	0
Gas-forming organisms in 0.1 cc	0
Gas-forming organisms in 0.01 cc	......

Holly Mineral Spring is situated at East Woonsocket, R. I., and is owned and operated by Mr. Stephen Wilcox. The spring was inspected December 2, 1907. Samples could not be obtained directly from source but were taken from a lead pipe connected with a cement basin inclosing the spring. The flow was approximately 40 gallons per hour, with a temperature of 46° F. Chemical analysis shows this to be a calcic, sodic, bicarbonated water of the alkaline type. The hypothetical combination indicates that approximately 57 per cent of the salts in solution are in the form of the bicarbonates of calcium, magnesium, and sodium, and 17 per cent are present as chlorid and sulphate of sodium. The sanitary analysis shows only a small amount of ammonia and nitrates, with absence of bacteria, which indicates organic purity. Inspection of the premises failed to reveal any probable sources of pollution. The advertised analysis, which is an incomplete statement of results, partially agrees with the analysis made by this bureau.

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[1] At 0° C. and 760 mm pressure in 1,000 cc of water.

RHODE ISLAND.

OCHEE SPRING.

(Alkaline.)

Misc. Div. No. 2425.

Chemical analysis.

Constituents.	Examination by Bureau of Chemistry.			Advertised analysis.[1]
	Amount of water used for each determination.	Analysis.	Total inorganic material in solution.	
Ions.	*Grams.*	*Parts per million.*	*Per cent.*	*Parts per million.*
Phosphoric acid (PO_4)	500	Trace.		
Metaboric acid (BO_2)	500	St. tr.		
Arsenic acid (AsO_4)	500	0.00		
Silica (SiO_2)	10,000	15.50	13.76	9.98
Sulphuric acid (SO_4)	4,000	10.00	8.87	18.44
Carbonic acid (CO_3)	100	.00		
Bicarbonic acid (HCO_3)	100	55.60	49.34	95.22
Nitric acid (NO_3)	100	1.80	1.60	
Nitrous acid (NO_2)	50	.00		
Chlorin (Cl)	250	3.34	2.96	5.94
Bromin (Br)	550	.00		
Iodin (I)	500	.00		
Iron (Fe)	1,000	.60	.53	9.02
Aluminum (Al)				
Manganese (Mn)	1,000	.00		
Calcium (Ca)	4,000	14.00	12.43	24.28
Magnesium (Mg)	4,000	3.60	3.20	5.61
Potassium (K)	4,000	3.20	2.84	6.80
Sodium (Na)	4,000	4.50	4.00	6.15
Lithium (Li)	4,000	[2] Trace.		
Ammonium (NH_4)	500	Trace.		
Oxygen (calculated) (O)		.53	.47	3.88
Total		112.67	100.00	185.32
Hypothetical Combinations.				
Ammonium chlorid (NH_4Cl)		Trace.		
Lithium chlorid (LiCl)		Trace.		
Potassium chlorid (KCl)		6.10	5.41	12.50
Potassium bromid (KBr)				
Potassium sulphate (K_2SO_4)				.53
Sodium nitrate ($NaNO_3$)		2.47	2.19	
Sodium nitrite ($NaNO_2$)				
Sodium chlorid (NaCl)		.72	.64	
Sodium sulphate (Na_2SO_4)		10.95	9.72	18.96
Sodium bicarbonate ($NaHCO_3$)				
Magnesium sulphate ($MgSO_4$)		3.26	2.89	6.69
Magnesium chlorid ($MgCl_2$)				
Magnesium bicarbonate ($Mg(HCO_3)_2$)		17.67	15.68	25.60
Calcium chlorid ($CaCl_2$)				
Calcium sulphate ($CaSO_4$)				
Calcium bicarbonate ($Ca(HCO_3)_2$)		54.29	48.19	98.16
Calcium phosphate ($Ca_3(PO_4)_2$)		Trace.		
Ferric oxid (Fe_2O_3)		.90	.80	12.90
Alumina (Al_2O_3)				
Ferrous bicarbonate ($Fe(HCO_3)_2$)				
Calcium silicate ($CaSiO_3$)		1.69	1.50	
Silica (SiO_2)		14.62	12.98	9.98
Total		112.67	100.00	185.32

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[1] Analysis (no date) by Prof. John H. Appleton. For purposes of comparison, recalculated from original data according to the scheme adopted by the Bureau of Chemistry.

[2] Spectroscopic trace.

RHODE ISLAND.

OCHEE SPRING.

Misc. Div. No. 2425.

Gases.[1]

	cc
Carbon dioxid (free)	4.4
Carbon dioxid (set free from bicarbonate upon evaporating to dryness)	10.1
Hydrogen sulphid	.0

Sanitary analysis.

	Parts per million.
Ammonia, free	Trace.
Ammonia albuminoid	0.030
Nitrogen as nitrites	.000
Nitrogen as nitrates	.404
Oxygen required	......
Bacteriological data:	
Organisms per cc on plain agar after 48 hours at 37° C	5
Organisms per cc on neutral red agar after 48 hours at 37° C	1
Gas-forming organisms in 5 cc	......
Gas-forming organisms in 1 cc	0
Gas-forming organisms in 0.1 cc	0
Gas-forming organisms in 0.01 cc	......

Ochee Spring is situated about 3 miles from Providence, R. I., and is owned and operated by the Ochee Spring Water Co. The spring was visited December 2, 1907, samples directly from source being obtained for examination. The flow was approximately 120 gallons per minute, with a temperature of 50° F. Chemical analysis shows this to be a calcic, bicarbonated water of the alkaline type. The hypothetical combination indicates that of the salts in solution, approximately 64 per cent are present as bicarbonates of calcium and magnesium, 10 per cent as sodium sulphate and a smaller quantity as magnesium sulphate. The sanitary analysis shows only small quantities of ammonia and nitrates with a very low bacterial count, which indicates organic purity. Inspection of the premises failed to reveal any probable source of pollution. The advertised analysis varies somewhat from the analysis of this bureau, especially in content of iron and calcium.

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[1] At 0° C. and 760 mm pressure in 1,000 cc of water.

CONNECTICUT.

ALTHEA SPRING.

(Alkaline-saline.)

Misc. Div. No. 4859.

Chemical analysis.

Constituents.	Examination by Bureau of Chemistry.			Advertised analysis.
	Amount of water used for each determination.	Analysis.	Total inorganic material in solution.	
IONS.	*Grams.*	*Parts per million.*	*Per cent.*	*Parts per million.*
Phosphoric acid (PO_4)	500	Ft. tr.		
Metaboric acid (BO_2)	500	0.00		
Arsenic acid (AsO_4)	500	.00		
Silica (SiO_2)	4,000	12.10	9.36	
Sulphuric acid (SO_4)	4,000	20.00	15.46	
Carbonic acid (CO_3)	100	.00		
Bicarbonic acid (HCO_3)	100	29.60	22.89	
Nitric acid (NO_3)	100	24.52	18.96	
Nitrous acid (NO_2)	100	Trace.		
Chlorin (Cl)	500	11.40	8.81	
Bromin (Br)	1,000	V. ft. tr.		
Iodin (I)	1,000	.00		
Iron (Fe) Aluminum	4,000	1.70	1.32	
Manganese (Mn)	4,000	.00		
Calcium (Ca)	4,000	14.40	11.14	
Magnesium (Mg)	4,000	4.80	3.71	
Potassium (K)	4,000	1.40	1.08	
Sodium (Na)	4,000	9.40	7.27	
Lithium (Li)	4,000	.00		
Ammonium (NH_4)	500	Trace.		
Oxygen (calculated) (O)				
Total		129.32	100.00	
HYPOTHETICAL COMBINATIONS.				
Ammonium chlorid (NH_4Cl)		Trace.		
Lithium chlorid (LiCl)		.00		
Potassium chlorid (KCl)		2.70	2.09	
Potassium bromid (KBr)				
Potassium sulphate (K_2SO_4)				
Sodium nitrate ($NaNO_3$)		33.62	26.00	
Sodium nitrite ($NaNO_2$)				
Sodium chlorid (NaCl)		.80	.62	
Sodium sulphate (Na_2SO_4)				
Sodium bicarbonate ($NaHCO_3$)				
Magnesium sulphate ($MgSO_4$)		7.40	5.72	
Magnesium chlorid ($MgCl_2$)		12.90	9.98	
Magnesium bicarbonate ($Mg(HCO_3)_2$)				
Calcium chlorid ($CaCl_2$)				
Calcium sulphate ($CaSO_4$)		20.00	15.46	
Calcium bicarbonate ($Ca(HCO_3)_2$)		34.40	26.60	
Calcium phosphate ($Ca_3(PO_4)_2$)				
Ferric oxid (Fe_2O_3)				
Alumina (Al_2O_3)				
Ferrous bicarbonate ($Fe(HCO_3)_2$)		5.40	4.17	
Calcium silicate ($CaSiO_3$)				
Silica (SiO_2)		12.10	9.36	
Total		129.32	100.00	

CONNECTICUT.

ALTHEA SPRING.

Misc. Div. No. 4859.

Gases.[1]

	cc
Carbon dioxid (free)	6.9
Carbon dioxid (set free from bicarbonate upon evaporating to dryness)	5.4

Sanitary analysis.

	Parts per million.
Ammonia, free	Trace.
Ammonia albuminoid	0.02
Nitrogen as nitrites	Trace.
Nitrogen as nitrates	5.55
Oxygen required	.14
Bacteriological data:	
Organisms per cc on plain agar after 48 hours at 37° C	......
Organisms per cc on neutral red agar after 48 hours at 37° C	......
Gas-forming organisms in 5 cc	......
Gas-forming organisms in 1 cc	......
Gas-forming organisms in 0.1 cc	......
Gas-forming organisms in 0.01 cc	......

Althea Spring is situated at Waterbury, Conn., and is owned and operated by the Diamond Bottling Corporation. It was inspected September 21, 1907. The water used by this company under the name of Althea Spring is, however, obtained from a well, the spring not yielding sufficient water to satisfy the demand. A sample of the well water was taken from the storage tank for the purpose of examination. Chemical analysis shows this to be a calcic, sodic, bicarbonated, nitrated, sulphated water of the alkaline-saline type. The hypothetical combination shows, that of the salts in solution approximately 26 per cent are in the form of calcium bicarbonate, 26 per cent of sodium nitrate, and 21 per cent of the sulphates of calcium and magnesium, with about 10 per cent of chlorid of magnesium. No advertised analysis could be obtained for purposes of comparison.

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[1] At 0° C. and 760 mm pressure in 1,000 cc of water.

CONNECTICUT.

ARETHUSA SPRING.

(Alkaline.)

Misc. Div. No. 4851.

Chemical analysis.

Constituents.	Examination by Bureau of Chemistry.			Advertised analysis.[1]
	Amount of water used for each determination.	Analysis.	Total inorganic material in solution.	
IONS.	*Grams.*	*Parts per million.*	*Per cent.*	*Parts per million.*
Phosphoric acid (PO_4)	500	0. 00		
Metaboric acid (BO_2)	500	. 00		
Arsenic acid (AsO_4)	500	. 00		
Silica (SiO_2)	4, 000	10. 30	24. 85	10. 44
Sulphuric acid (SO_4)	4, 000	3. 70	8. 93	3. 26
Carbonic acid (CO_3)	100	. 00		
Bicarbonic acid (HCO_3)	100	15. 10	36. 44	12. 05
Nitric acid (NO_3)	100	. 66	1. 59	. 44
Nitrous acid (NO_2)	100	. 00		. 00
Chlorin (Cl)	500	2. 80	6. 76	2. 57
Bromin (Br)	1, 000	V. ft. tr.		
Iodin (I)	1, 000	. 00		
Iron (Fe) }	4, 000	. 20	. 49	. 10
Aluminum (Al) }				
Manganese (Mn)	4, 000	. 00		
Calcium (Ca)	4, 000	3. 10	7. 48	2. 97
Magnesium (Mg)	4, 000	1. 00	2. 41	. 63
Potassium (K)	4, 000	. 90	2. 17	. 73
Sodium (Na)	4, 000	3. 60	8. 69	2. 91
Lithium (Li)	4, 000	[2] Trace.		
Ammonium (NH_4)	500	Trace.		. 00
Oxygen (calculated) (O)		. 08	. 19	. 05
Total		41. 44	100. 00	36. 15
HYPOTHETICAL COMBINATIONS.				
Ammonium chlorid (NH_4Cl)		Trace.		
Lithium chlorid (LiCl)				
Potassium chlorid (KCl)		1. 70	4. 10	1. 39
Potassium bromid (KBr)				
Potassium sulphate (K_2SO_4)				
Sodium nitrate ($NaNO_3$)		. 91	2. 20	. 60
Sodium nitrite ($NaNO_2$)				
Sodium chlorid (NaCl)		3. 30	7. 96	3. 15
Sodium sulphate (Na_2SO_4)		5. 45	13. 15	4. 66
Sodium bicarbonate ($NaHCO_3$)		1. 10	2. 65	
Magnesium sulphate ($MgSO_4$)				. 14
Magnesium chlorid ($MgCl_2$)				
Magnesium bicarbonate ($Mg(HCO_3)_2$)		6. 00	14. 48	3. 61
Calcium chlorid ($CaCl_2$)				
Calcium sulphate ($CaSO_4$)				
Calcium bicarbonate ($Ca(HCO_3)_2$)		12. 40	29. 93	12. 01
Calcium phosphate ($Ca_3(PO_4)_2$)				
Ferric oxid (Fe_2O_3)		. 28	. 68	. 15
Alumina (Al_2O_3)				
Ferrous bicarbonate ($Fe(HCO_3)_2$)				
Calcium silicate ($CaSiO_3$)				
Silica (SiO_2)		10. 30	24. 85	10. 44
Total		41. 44	100. 00	36. 15

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[1] Advertised analysis made in 1894 by Prof. R. H. Chittenden. For purposes of comparison, recalculated from original data according to the scheme adopted by the Bureau of Chemistry.

[2] Spectroscopic trace.

CONNECTICUT.

ARETHUSA SPRING.

Misc. Div. No. 4851.

Gases.[1]

	cc
Carbon dioxid (free)	2.8
Carbon dioxid (set free from bicarbonate upon evaporating to dryness)	2.7
Hydrogen sulphid	.0

Sanitary analysis.

	Parts per million.
Ammonia, free	Trace.
Ammonia albuminoid	0.02
Nitrogen as nitrites	.00
Nitrogen as nitrates	.15
Oxygen required	.12
Bacteriological data:	
Organisms per cc on plain agar after 48 hours at 37° C	0
Organisms per cc on neutral red agar after 48 hours at 37° C	0
Gas-forming organisms in 5 cc	......
Gas-forming organisms in 1 cc	0
Gas-forming organisms in 0.1 cc	0
Gas-forming organisms in 0.01 cc	......

The Arethusa Spring is located at Seymour, Conn., and is owned and operated by the Arethusa Spring Water Co. Inspection of the spring was made December 6, 1907, samples directly from source being obtained for examination. The flow is approximately 5 gallons per minute, with a temperature of 49° F. Chemical analysis shows this to be a lightly mineralized, sodic, calcic, bicarbonated water of the alkaline type. The hypothetical combination indicates that approximately 44 per cent of the salts in solution are in the form of bicarbonates of calcium and magnesium and approximately 13 per cent of sulphate of sodium. The sanitary analysis shows only traces of free ammonia and small quantities of albuminoid ammonia and nitrates, which, with an absence of bacteria, indicates organic purity. Inspection of the premises failed to reveal any probable sources of pollution. The advertised analysis made in 1894 agrees fairly well with the analysis made by this bureau.

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[1] At 0° C. and 760 mm pressure in 1,000 cc of water.

CONNECTICUT.

CHERRY HILL SPRING.

(Alkaline-saline.)

Misc. Div. No. 4848.

Chemical analysis.

Constituents.	Examination by Bureau of Chemistry.			Advertised analysis.[1]
	Amount of water used for each determination.	Analysis.	Total inorganic material in solution.	
IONS.	*Grams.*	*Parts per million.*	*Per cent.*	*Parts per million.*
Phosphoric acid (PO_4)	500	0.00		
Metaboric acid (BO_2)	500	.00		
Arsenic acid (AsO_4)	500	.00		
Silica (SiO_2)	4,000	13.80	16.98	
Sulphuric acid (SO_4)	4,000	6.10	7.50	
Carbonic acid (CO_3)	100	.00		
Bicarbonic acid (HCO_3)	100	27.20	33.47	
Nitric acid (NO_3)	100	12.15	14.95	
Nitrous acid (NO_2)	100	.00		
Chlorin (Cl)	500	3.80	4.67	
Bromin (Br)	1,000	.00		
Iodin (I)	1,000	.00		
Iron (Fe)	4,000	.30	.37	
Aluminum (Al)				
Manganese (Mn)	4,000			
Calcium (Ca)	4,000	10.30	12.67	
Magnesium (Mg)	4,000	1.60	1.97	
Potassium (K)	4,000	.70	.86	
Sodium (Na)	4,000	5.20	6.39	
Lithium (Li)	4,000	[2] V. ft. tr.		
Ammonium (NH_4)	500	.00		
Oxygen (calculated) (O)		.13	.17	
Total		81.28	100.00	
HYPOTHETICAL COMBINATIONS.				
Ammonium chlorid (NH_4Cl)				
Lithium chlorid (LiCl)		V. ft. tr.		
Potassium chlorid (KCl)		1.30	1.59	
Potassium bromid (KBr)				
Potassium sulphate (K_2SO_4)				
Sodium nitrate ($NaNO_3$)		16.65	20.48	
Sodium nitrite ($NaNO_2$)				
Sodium chlorid (NaCl)		1.20	1.48	
Sodium sulphate (Na_2SO_4)				
Sodium bicarbonate ($NaHCO_3$)				
Magnesium sulphate ($MgSO_4$)		3.50	4.31	
Magnesium chlorid ($MgCl_2$)		3.60	4.43	
Magnesium bicarbonate ($Mg(HCO_3)_2$)				
Calcium chlorid ($CaCl_2$)				
Calcium sulphate ($CaSO_4$)		4.70	5.78	
Calcium bicarbonate ($Ca(HCO_3)_2$)		36.10	44.41	
Calcium phosphate ($Ca_3(PO_4)_2$)				
Ferric oxid (Fe_2O_3)		.43	.54	
Alumina (Al_2O_3)				
Ferrous bicarbonate ($Fe(HCO_3)_2$)				
Calcium silicate ($CaSiO_3$)				
Silicia (SiO_2)		13.80	16.98	
Total		81.28	100.00	

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[1] Advertised analysis, sanitary only, of no value for purposes of comparison.
[2] Spectroscopic trace.

CONNECTICUT.

CHERRY HILL SPRING.

Misc. Div. No. 4848.

Gases.[1]

	cc
Carbon dioxid (free)	4.0
Carbon dioxid (set free from bicarbonate upon evaporating to dryness)	5.0
Hydrogen sulphid	.0

Sanitary analysis.

	Parts per million.
Ammonia, free	0.00
Ammonia albuminoid	.02
Nitrogen as nitrites	.00
Nitrogen as nitrates	2.75
Oxygen required	.12
Bacteriological data:	
Organisms per cc on plain agar after 48 hours at 37° C	3
Organisms per cc on neutral red agar after 48 hours at 37° C	1
Gas-forming organisms in 5 cc	....
Gas-forming organisms in 1 cc	....
Gas-forming organisms in 0.1 cc	0
Gas-forming organisms in 0.01 cc	0

Cherry Hill Spring is situated at Highwood, near New Haven, Conn. It is owned by Mr. H. B. Graham. The spring was inspected December 6, 1907, samples directly from source being obtained for examination. The flow was approximately 10 gallons per minute, with a temperature of 49° F. Chemical analysis shows this to be a calcic, bicarbonated, nitrated water of the alkaline-saline type. The hypothetical combination shows that of the salts in solution approximately 44 per cent are in the form of the bicarbonate of calcium, 20 per cent of sodium nitrate, and smaller amounts of magnesium salts. The sanitary analysis shows only a small quantity of albuminoid ammonia and a rather large amount of nitrogen in the form of nitrate, while the bacterial count is low. Inspection of the premises failed to reveal any probable sources of pollution. No advertised analysis of this water could be obtained for purposes of comparison.

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[1] At 0° C. and 760 mm pressure in 1,000 cc of water.

CONNECTICUT

LIVE OAK SPRING.

(Alkaline.)

Misc. Div. No. 4850.

Chemical analysis.

Constituents.	Examination by Bureau of Chemistry.			Advertised analysis.
	Amount of water used for each determination.	Analysis.	Total inorganic material in solution.	
Ions.	*Grams.*	*Parts per million.*	*Per cent.*	*Parts per million.*
Phosphoric acid (PO_4)	500	Trace.		
Metaboric acid (BO_2)	500	0.00		
Arsenic acid (AsO_4)	500	.00		
Silica (SiO_2)	4,000	26.60	15.30	
Sulphuric acid (SO_4)	4,000	12.00	6.90	
Carbonic acid (CO_3)	100	.00		
Bicarbonic acid (HCO_3)	100	90.90	52.29	
Nitric acid (NO_3)	100	2.45	1.41	
Nitrous acid (NO_2)	100	.00		
Chlorin (Cl)	500	4.00	2.30	
Bromin (Br)	1,000	.00		
Iodin (I)	1,000	.00		
Iron (Fe) Aluminum (Al)	4,000	.30	.17	
Manganese (Mn)	4,000	.00		
Calcium (Ca)	4,000	24.80	14.26	
Magnesium (Mg)	4,000	4.40	2.53	
Potassium (K)	4,000	.80	.46	
Sodium (Na)	4,000	7.20	4.14	
Lithium (Li)	4,000	.00		
Ammonium (NH_4)	500	Trace.		
Oxygen (calculated) (O)		.43	.24	
Total		173.88	100.00	
Hypothetical Combinations.				
Ammonium chlorid (NH_4Cl)		Trace.		
Lithium chlorid (LiCl)				
Potassium chlorid (KCl)		1.50	.86	
Potassium bromid (KBr)				
Potassium sulphate (K_2SO_4)				
Sodium nitrate ($NaNO_3$)		3.35	1.93	
Sodium nitrite ($NaNO_2$)				
Sodium chlorid (NaCl)		5.40	3.10	
Sodium sulphate (Na_2SO_4)		13.00	7.48	
Sodium bicarbonate ($NaHCO_3$)				
Sodium metaborate ($NaBO_2$)				
Magnesium sulphate ($MgSO_4$)		4.00	2.30	
Magnesium bicarbonate ($Mg(HCO_3)_2$)		21.60	12.42	
Calcium chlorid ($CaCl_2$)				
Calcium sulphate ($CaSO_4$)				
Calcium bicarbonate ($Ca(HCO_3)_2$)		96.90	55.72	
Calcium phosphate ($Ca_3(PO_4)_2$)				
Ferric oxid (Fe_2O_3) Alumina (Al_2O_3)		.43	.25	
Ferrous bicarbonate ($Fe(HCO_3)_2$)				
Calcium silicate ($CaSiO_3$)		2.30	1.32	
Silica (SiO_2)		25.40	14.62	
Total		173.88	100.00	

CONNECTICUT.

LIVE OAK SPRING.

Misc. Div. No. 4850.

Gases.[1]

	cc
Carbon dioxid (free)	6.8
Carbon dioxid (set free from bicarbonate upon evaporating to dryness)	16.7
Hydrogen sulphid	.0

Sanitary analysis.

	Parts per million.
Ammonia, free	Trace.
Ammonia albuminoid	0.030
Nitrogen as nitrites	.000
Nitrogen as nitrates	.555
Oxygen required	.050
Bacteriological data:	
Organisms per cc on plain agar after 48 hours at 37° C	64,000
Organisms per cc on neutral red agar after 48 hours at 37° C	45,000
Gas-forming organisms in 5 cc	....
Gas-forming organisms in 1 cc	+
Gas-forming organisms in 0.1 cc	0
Gas-forming organisms in 0.01 cc	....

Live Oak Spring is situated in Meriden, Conn., and is owned by the Parker Manufacturing Co. The spring was inspected December 7, 1907, samples directly from source being obtained for examination. The flow is said to be approximately 21,000 gallons in twenty-four hours and had a temperature of 51° F. Chemical analysis shows this to be a moderately mineralized, calcic, bicarbonated water of the alkaline type. The hypothetical combination indicates that approximately 68 per cent of the salts in solution are in the form of bicarbonates of calcium and magnesium, and that smaller amounts of the sulphates of sodium and magnesium are present. The sanitary analysis shows small amounts of albuminoid ammonia and nitrates, but a very high bacterial count, gas-forming organisms being present in 1 cc quantity. The water is, therefore, of doubtful purity. Inspection of the premises and surroundings shows the presence of possible sources of pollution. No advertised analysis of the water could be obtained for purposes of comparison.

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[1] At 0° C. and 760 mm pressure in 1,000 cc of water.

CONNECTICUT.

MOHICAN SPRING.

(Alkaline.)

Misc. Div. No. 4858.

Chemical analysis.

Constituents.	Examination by Bureau of Chemistry.			Advertised analysis.
	Amount of water used for each determination.	Analysis.	Total inorganic material in solution.	
IONS.	*Grams.*	*Parts per million.*	*Per cent.*	*Parts per million.*
Phosphoric acid (PO_4)	500	Trace.		
Metaboric acid (BO_2)	500	Trace.		
Arsenic acid (AsO_4)	500	0.00		
Silica (SiO_2)	4,000	12.60	23.32	5.99
Sulphuric acid (SO_4)	4,000	3.90	7.22	1.30
Carbonic acid (CO_3)	100	.00		
Bicarbonic acid (HCO_3)	100	21.20	39.23	12.09
Nitric acid (NO_3)	100	.66	1.22	.13
Nitrous acid (NO_2)	100	.00		.01
Chlorin (Cl)	500	3.60	6.66	18.34
Bromin (Br)	1,000	.00		
Iodin (I)	1,000	.00		St. tr.
Iron (Fe) Aluminum (Al)	4,000	.20	.37	.82
Manganese (Mn)	4,000	.00		
Calcium (Ca)	4,000	4.10	7.58	2.18
Magnesium (Mg)	4,000	1.30	2.41	1.45
Potassium (K)	4,000	1.10	2.03	4.51
Sodium (Na)	4,000	5.10	9.44	9.26
Lithium (Li)	4,000	.00		
Ammonium (NH_4)	500	Trace.		.01
Oxygen (calculated) (O)		.28	.52	.35
Total		54.04	100.00	56.44
HYPOTHETICAL COMBINATIONS.				
Ammonium chlorid (NH_4Cl)		Trace.		.03
Lithium chlorid (LiCl)				
Potassium chlorid (KCl)		2.10	3.89	8.60
Potassium bromid (KBr)				
Potassium sulphate (K_2SO_4)				
Sodium nitrate ($NaNO_3$)		.91	1.68	.18
Sodium nitrite ($NaNO_2$)				.02
Sodium chlorid (NaCl)		4.25	7.86	23.35
Sodium sulphate (Na_2SO_4)		5.80	10.73	
Sodium bicarbonate ($NaHCO_3$)		4.70	8.70	
Magnesium sulphate ($MgSO_4$)				1.63
Magnesium chlorid ($MgCl_2$)				.11
Magnesium bicarbonate ($Mg(HCO_3)_2$)		7.80	14.43	6.55
Calcium chlorid ($CaCl_2$)				
Calcium sulphate ($CaSO_4$)				
Calcium bicarbonate ($Ca(HCO_3)_2$)		15.00	27.76	8.81
Calcium phosphate ($Ca_3(PO_4)_2$)				
Ferric oxid (Fe_2O_3)		.28	.52	1.17
Alumina (Al_2O_3)				
Ferrous bicarbonate ($Fe(HCO_3)_2$)				
Calcium silicate ($CaSiO_3$)		1.20	2.22	
Silica (SiO_2)		12.00	22.21	5.99
Total		54.04	100.00	56.44

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[1] Advertised analysis made in 1904 by Sylvester P. Wheeler. For purposes of comparison, recalculated from original data according to the scheme adopted by the Bureau of Chemistry.

CONNECTICUT.

MOHICAN SPRING.

Misc. Div. No. 4858.

Gases.[1]

	cc
Carbon dioxid (free)	8.4
Carbon dioxid (set free from bicarbonate upon evaporating to dryness)	3.9
Hydrogen sulphid	.0

Sanitary analysis.

	Parts per million.
Ammonia, free	Trace.
Ammonia albuminoid	0.02
Nitrogen as nitrites	.00
Nitrogen as nitrates	.15
Oxygen required	.04
Bacteriological data:	
Organisms per cc on plain agar after 48 hours at 37° C	1
Organisms per cc on neutral red agar after 48 hours at 37° C	0
Gas-forming organisms in 5 cc	......
Gas-forming organisms in 1 cc	......
Gas-forming organisms in 0.1 cc	0
Gas-forming organisms in 0.01 cc	0
B. coli communis	......
Streptococci	......

The Mohican Spring is situated about 5 miles from Bridgeport, Conn. The spring was inspected December 5, 1907, samples directly from source being obtained for examination. The flow was approximately 30 gallons per minute, with a temperature of 43° F. The chemical analysis shows this to be a lightly mineralized, sodic, calcic, bicarbonated water of the alkaline type. Hypothetical combination indicates that approximately 51 per cent of the salts in solution are in the form of bicarbonates of calcium, magnesium, and sodium, with smaller amounts of the sulphate and chlorid of sodium. Sanitary analysis shows only a small amount of albuminoid ammonia and nitrate, which, with a very low bacterial count, indicates organic purity. Inspection of the premises failed to reveal any probable sources of pollution. The advertised analysis made in 1904 is in fairly close agreement with that made by this bureau, with the exception of sodiun and chlorin, which have apparently decreased since the former analysis was made.

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[1] At 0° C. and 760 mm pressure in 1,000 cc of water.

INDEX TO ANALYSES OF WATERS ARRANGED ACCORDING TO CLASS.

INDEX TO ANALYSES OF WATERS ARRANGED ALPHABETICALLY ACCORDING TO NAME.

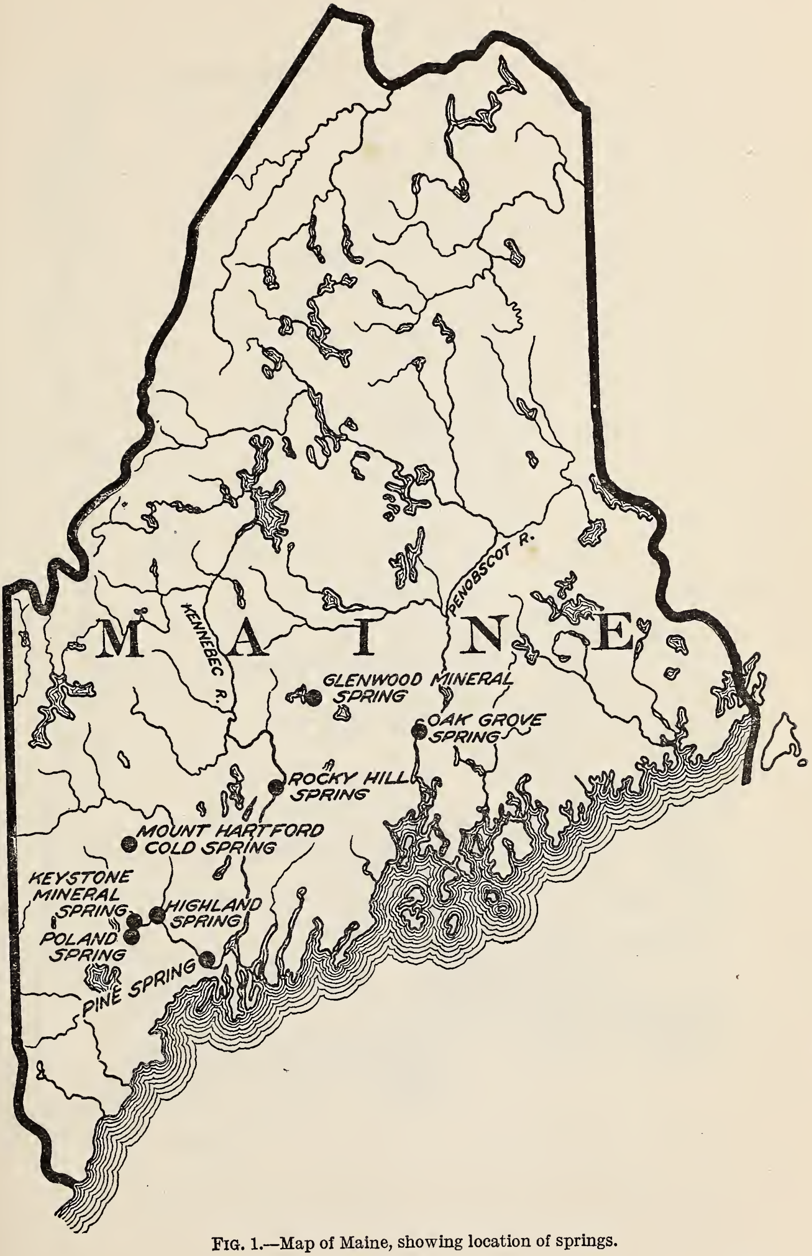

FIG. 1.—Map of Maine, showing location of springs.

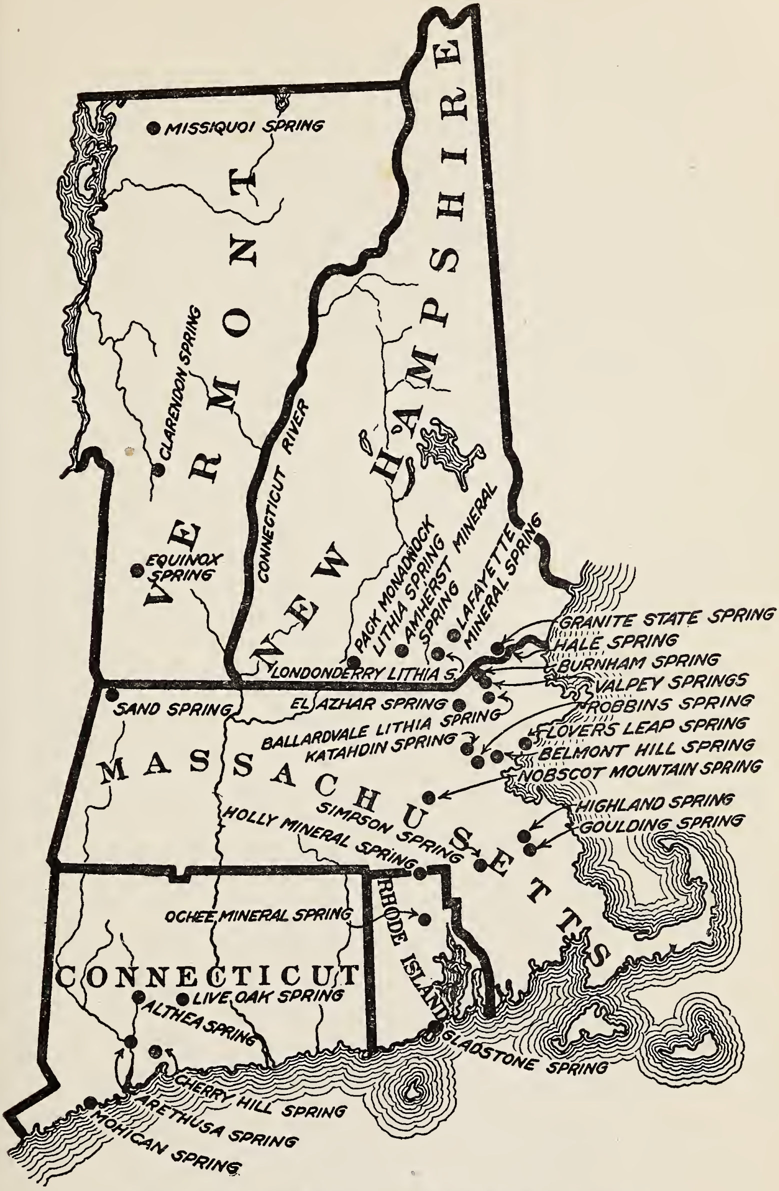

FIG. 2.—Map of New England States, showing location of springs.

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